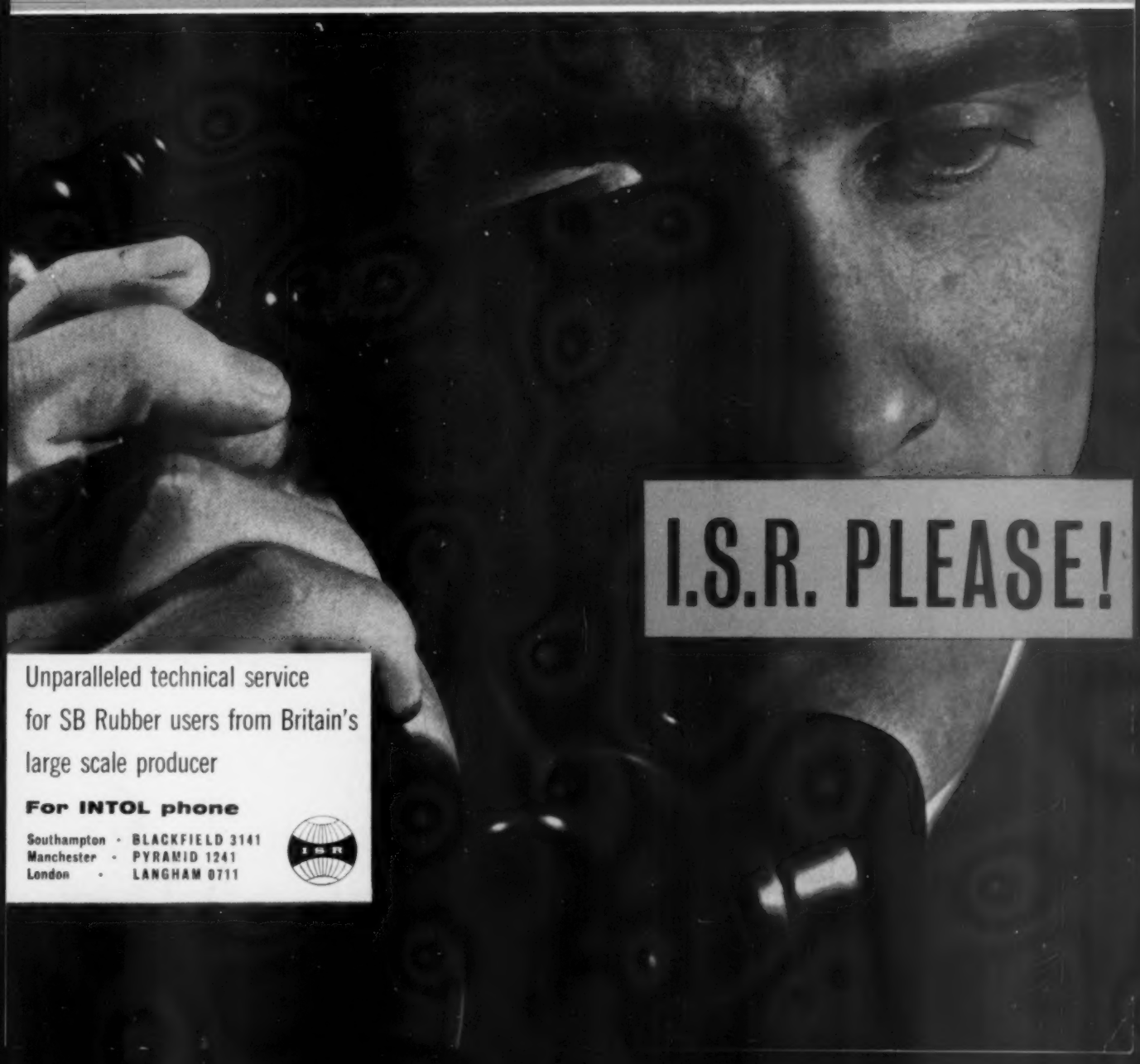
RUBBER and PLASTICS WEEKLY

VOLUME 140 NO. 12 MARCH 25 1961 ONE SHILLING



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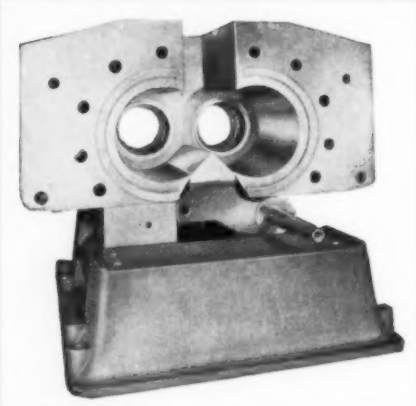
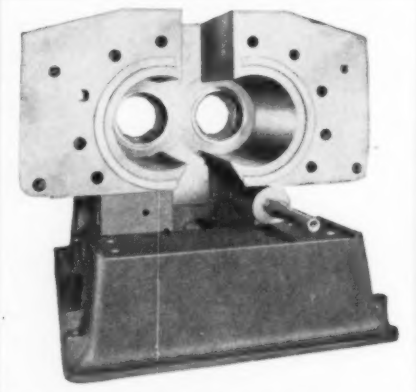
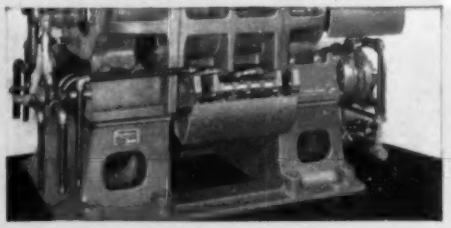
* *Banbury is a registered trade mark in many countries throughout the world*



Chamber of Banbury with drop door in closed position



Drop door partially open



Angular view of drop door in open position

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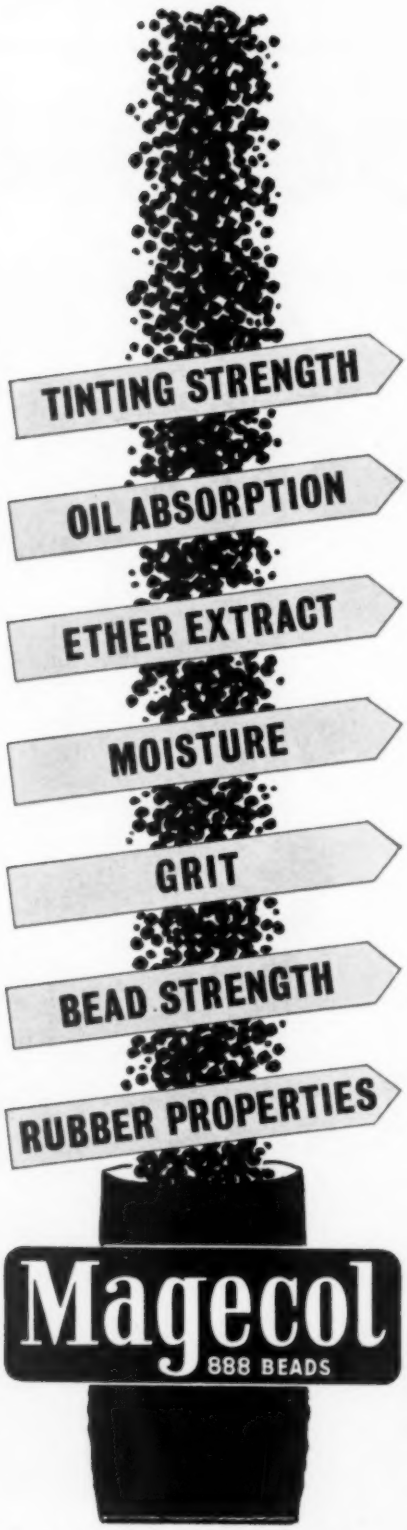

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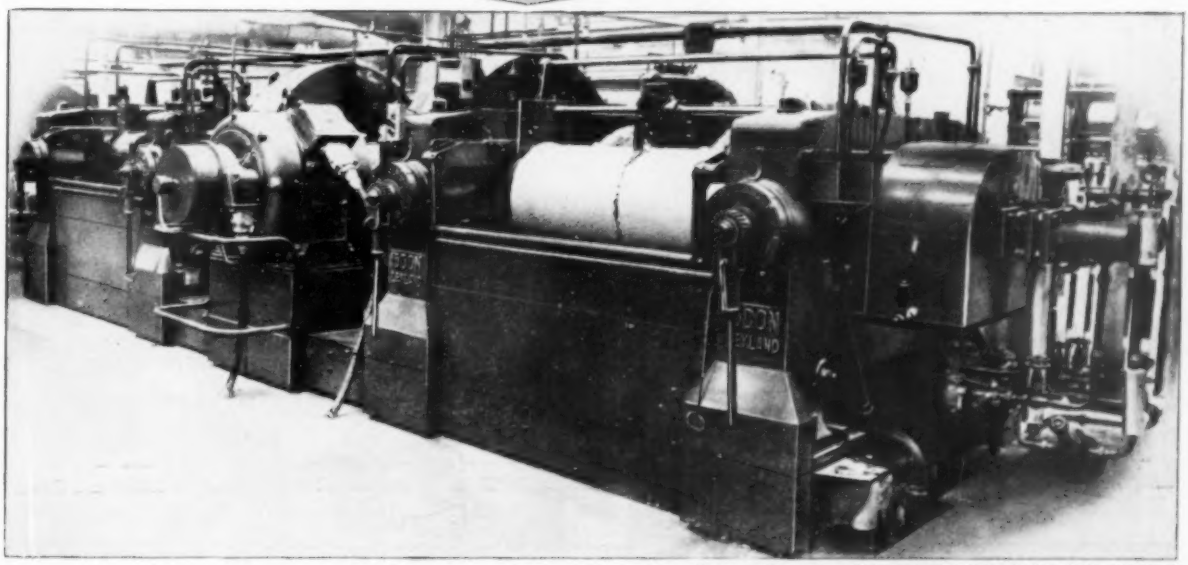

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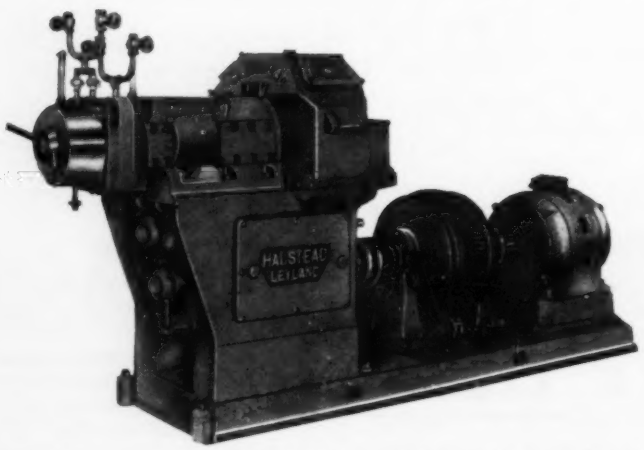

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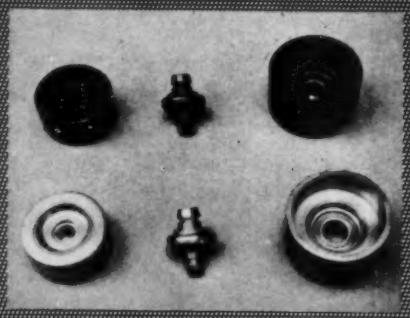

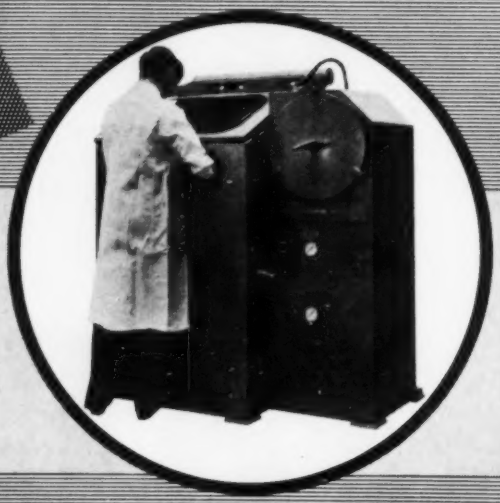

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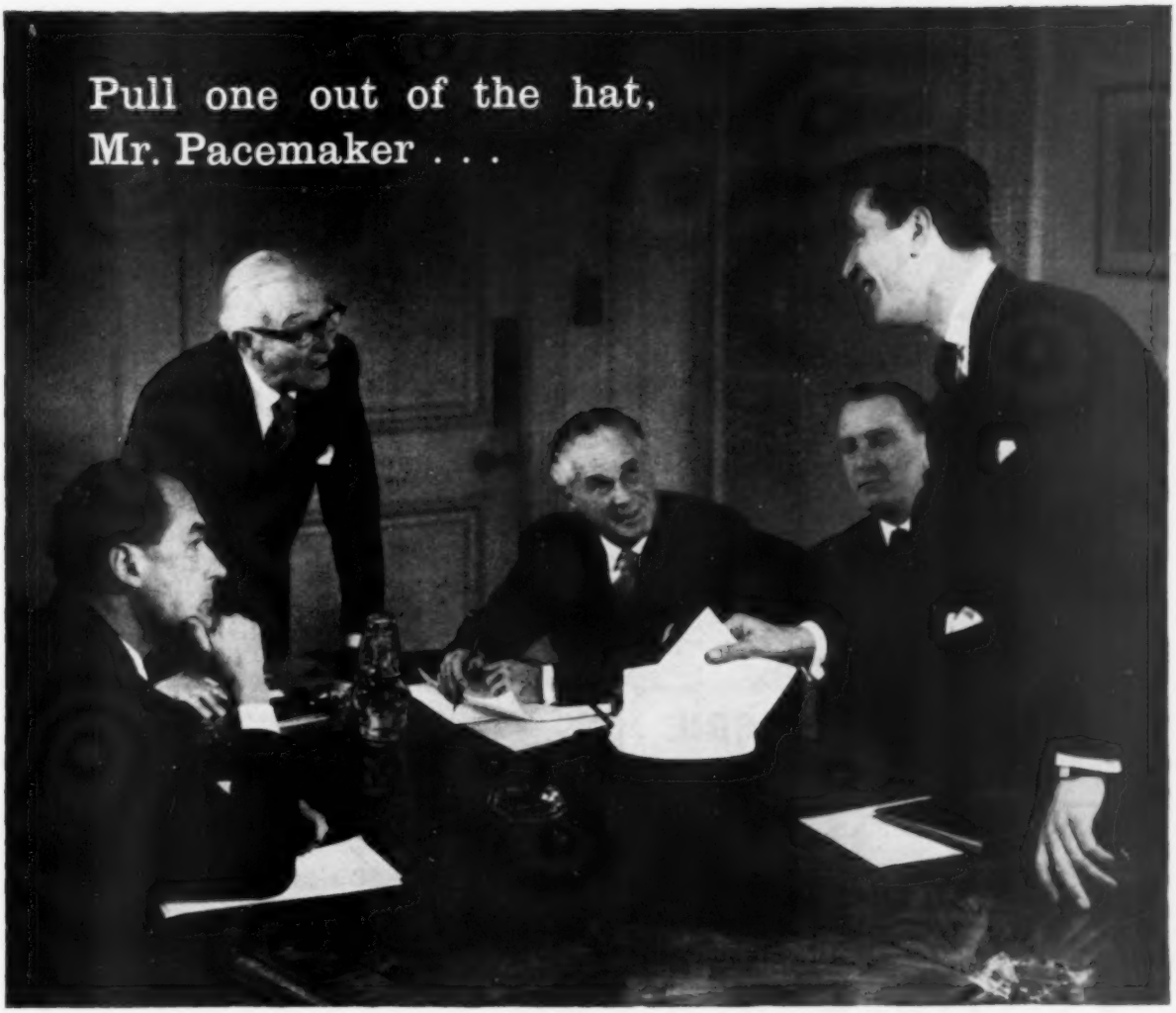

. . . show 'em a price from Phoenix!

Imagine it. Management meeting. General Manager speaking. "Referring to our last meeting, it looks as though we must very reluctantly turn down the enquiry from Willards. Their cost ceiling is rather low . . ." *Here's your chance! A slight clearing of the throat to attract attention, then speak.* "Err-mmm. Excuse me if I interrupt, Mr. Matthews. Since our last meeting, I have followed up a lead, and I am now very happy to inform you that I have a price for the rubber compound which will allow us our usual profit margin on the components, and still keep us below Willard's ceiling." *Ah! that's got 'em. Old Matthews doesn't seem to believe it . . . pass him the quotation. That know-all Skinner looks really put-out. Chairman's nodding the way he always does when he's pleased. Tell them the rest.* "Firm called Phoenix Rubber Co. Ltd. Seem to be an—er—elastic sort of organisation. Geared to handle the special mixes we want at an economic cost. Yes, Mr. Matthews, I'll have the representative call tomorrow. Thank you sir."

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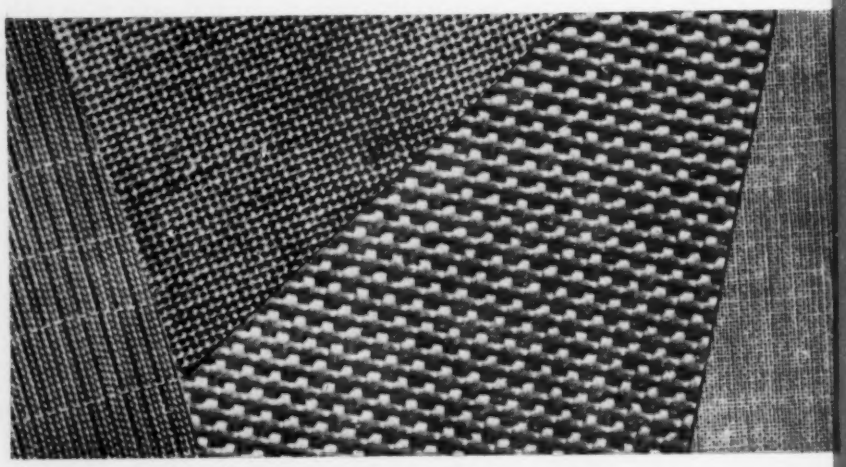

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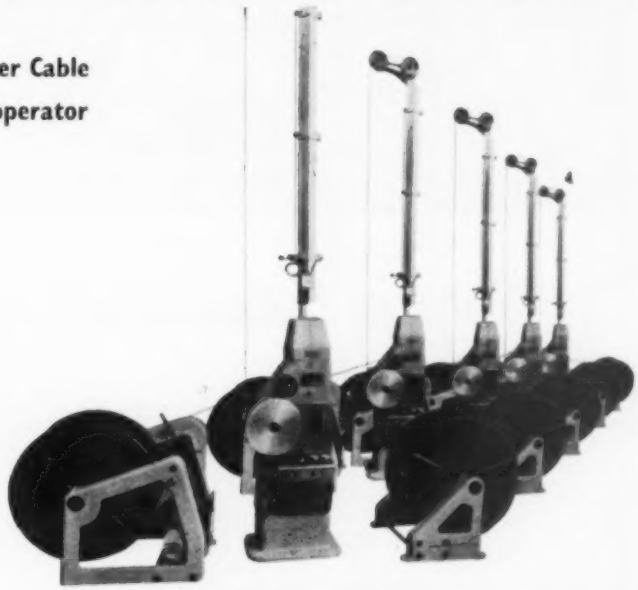

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Polymer Corporation's new Strasbourg plant will provide convenient source of rubber for the European market

Early this summer, construction of a new Polymer Corporation plant is scheduled to begin on a site of 70 hectares near Strasbourg. Choice of the site was determined by the transportation advantages of its situation on the Rhine, by the manufacturing advantages of its position on the route of the crude oil pipeline from the Mediterranean to proposed refineries, and by the marketing benefits of its proximity to the principal European rubber-consuming areas.

When the plant comes into full operation in the summer of 1962, it will produce 10,000 long tons of specialty rubbers annually. Its operation will be directed by Polymer Corporation (SAF) with technical advice provided by the parent company, Polymer Corporation Limited, Sarnia, Canada. A stable work force is assured from local employment.

Initially, the plant will produce a range of specialty rubbers and latices for the rubber and allied industries. Ample provision will be made, however, for production facilities to expand to include rubbers of all types for the rapidly growing markets both in Europe and abroad.

The Company's object in establishing the Strasbourg plant is twofold—to enable it to strengthen its position as a major supplier of rubber, and to provide its many customers in the area with improved service through reduced delivery times.

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RUBBER and PLASTICS WEEKLY

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Volume 140 *IN ITS 77th YEAR* **No. 12**

March 25 1961

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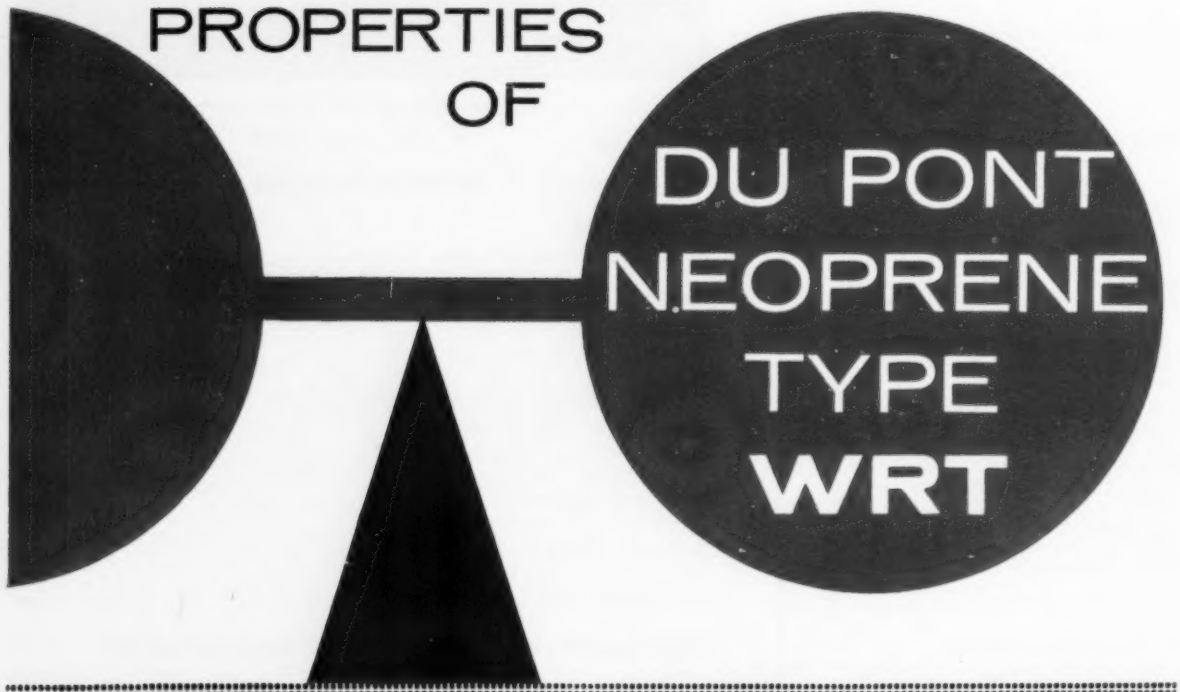

IN YOUR PLANT

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NOTES of the WEEK

The Fight Against Corrosion

TODAY the country has lost £1.6m. It will lose the same amount tomorrow and the same the day after that — all due to corrosion, the yearly bill for which is estimated to come to £600m. It is certain, however, that in the years to come this figure will diminish — at least in proportion to the capital involved — as more methods of controlling corrosion are developed and, more important perhaps, put into practice. Rubber and plastics are playing a major part in the fight against corrosion, and, in order that readers can have an overall picture of current trends, we are publishing this week a special feature on corrosion.

Since the 1920s rubber linings and coverings have been widely used by the chemical and other industries to protect equipment. The introduction of neoprene in 1932, followed by the development of other synthetics, widened the scope of the rubber manufacturer's anti-corrosion service.

Accurate Specifications

SINCE the war, plastics have been brought into the battle against rust as dipped and sprayed coatings, as paints, and as corrosion-resistant structures. A recent outstanding product development is the production of high-pressure epoxy/glass pipe by a nearly automatic process. There are still a number of snags to be overcome before this type of pipe becomes widely accepted, but the potential market — which includes pressure pipelines for the petroleum industry — is enormous. This kind of development is an indication of the way polymers are going in the fight against corrosion: products are becoming more and more tightly tailored to meet specific applications. It is essential, in fact, that rubber and plastics manufacturers should find out exactly how a product will be used, and what the service conditions will be. The customer may be so vague in his order that he specifies rigid pvc piping, although the working temperature will reach 80°C. Such misuse of plastics may be the customer's fault, but all too frequently he will blame the material for not doing what it was never intended to do.

The best way to avoid this kind of incident is to insist on an accurate specification, and, on the rubber side, the Federation of British Rubber and Allied Manufacturers' 'Guide to the Drafting of a Specification' is proving very useful in this connexion. Another important point is that, as one of the contributors to our special feature points out, a manufacturer providing a corrosion service to a plant under construction should be called in at the beginning — when the project is still on the drawing board.

Image of a Firm

BUSINESSES are like people, in that each has its own personality. This 'image' of a firm is built up from a number of impressions formed by a number of people — and, in this context, the small things count. You may be the most polite and considerate of executives, but if your secretary is short-tempered, or the receptionist likes to exercise a sense of power by keeping people waiting, then he is a very balanced man indeed who does not attach some of this rudeness to you — and to your firm.

One rubber firm that is careful about the reception it gives to visitors is George MacLellan and Co. Ltd. This Glasgow firm has just established new offices as part of a general development plan, and with them a new way of receiving visitors. Each visitor is given a folder, which tells him that he is equally welcome whether he comes to buy or to sell. 'We shall give our visitors the same considerate hearing that we hope our own salesmen will receive', the folder says. 'We cannot buy from everyone . . . just as we cannot (unfortunately) sell to everyone! A telephone call in advance will make certain that we meet you. Your time is just as valuable as ours. Nothing is more frustrating than having to wait unnecessarily. Please make an appointment whenever possible'.

The folder also actually contains the names of people to call on, both on the buying and the selling side; a revelation to the salesman who has often been told that his contact is Mr Jones, and after four or five attempts, sees Mr Jones and is told that it is nothing to do with him, he should really see Mr Brown.

MacLellan tells a story of the old days of deep trade secrets, when spies were suspected to be everywhere. A minister showed a surprising interest in the Glasgow factory. When handed a knife to cut a piece of rubber, he dipped it first into water . . . and was promptly shown the door. If he knew enough to wet the blade before cutting, he knew too much for the peace of mind of the company. These days are well buried in the past, but some firms could still do with a form of what might be called 'personality adjustment'. MacLellan's idea of welcome may not be entirely original, but it is far from being widely adopted in this country; if it were it would make the wheels of industry spin more cheerfully — and perhaps a little faster.

NEWS *Briefs*

INDONESIAN ESTATES OCCUPIED — US RUBBER FIRM IN EEC — BAYER IN BELGIUM — GOODRICH DIENE PLANT — ARGENTINE RUBBER DEMAND

●**Sweden** — Dunlop Seafarer inflatable liferafts have been ordered for two Russian tankers, now being built in Sweden. Each ship will carry one 20-man and one 10-man liferaft. The stowages for these will be fitted with Dunlop hydrostatic release units, ensuring the automatic release of the stowed liferaft in the event of a sinking.

●**West Germany** — The Düsseldorf firm of Battenfeld is planning to establish a plastics machinery factory in Ireland at Ringsend, near Dublin. It is expected to employ 200 workers.

●**Ceylon** — Talks for the renewal of the rubber/rice pact between Ceylon and China have been concluded in Colombo. It is said that China has agreed to pay 5 cents more than ruling Singapore prices for every lb. of rubber bought from Ceylon. Last year, Ceylon bought 160,000 metric tons of rice in exchange for 17,000 metric tons of rubber.

●**Yugoslavia** — Yugoslavia has bought about 5,000 tons of Indonesian rubber so far this year, according to agency reports.

●**Turkey** — An American company is reported to be associating itself with the Sakarya Rubber Industry Corp. in the operation of a tyre factory under construction by the Corporation at Arifiye, near Adapazari. The plant will have a capacity of 250 000 tyres annually. A Pirelli tyre plant with an initial output of 120,000 tyres and tubes is also under construction in Turkey.

●**South Africa** — Brookhirst Igranic, a company in the Metal Industries group, has received an order to supply control equipment for a new factory which is being erected by South African Titan Products in Umbogintwini. The factory will produce titanium dioxide.

●**Belgium** — Construction will begin at the end of this month of a $4m. rubber plant at Erembodegem, Belgium, the US firm Gates Rubber Co. has announced. Production of belts and hose at the plant, for sale in the Common Market, will begin by the end of the year. Belts will be made for motor car, industrial, agricultural, light duty and variable speed use. The plant will manufacture wire-braided, and moulded hose.

●**United States** — The Goodrich-Gulf cis-polybutadiene rubber plant at Institute, West Virginia, is expected to be on stream by the end of this year (*RPW* February 4, 168). It will have an initial capacity of 20m. lb. a year.

●**Belgium** — Farbenfabriken Bayer has selected a site in Belgium for the establishment of its fifth factory. Negotiations are under way for the acquisition of a 370-acre site at Antwerp, where the factory is to be set up close to the port.

●**Colombia** — A plant is to be built near Bogota by Grace Chemical Co. Ltd. to produce phthalic anhydride and plasticizers.

●**Indonesia** — The Belgian Ambassador in Indonesia, L. A. Van Den Berghe, has asked the Foreign Minister, Dr Subandrio, for an explanation of the Indonesian army's occupation of Belgian estates in North Sumatra. The army took over the estates this week. An Indonesian army spokesman, Lieut.-Col. Sunario, said in Djakarta that about 30 rubber and palm oil estates were involved in the takeover. He stated that the action by the army was necessary 'in view of existing chaos among the workers on the plantations'. The army had merely taken protective measures in order to prevent further trouble and ensure the safety of the plantations, he added.

●**Japan** — The Kurashiki Rayon Co. has announced that it has licensed companies in USA, France and West Germany to use its technique for producing polyvinyl alcohol and vinylon fibres. It is negotiating similar contracts with firms in the UK, USSR, Rumania, Yugoslavia and Italy.

●**Canada** — An export order valued at £25,000 has been received by Matthew Wylie and Co. Ltd., of Glasgow, for blow moulding machinery for the production of detergent bottles in Canada. The equipment will be shipped within two months.

●**Argentina** — In connexion with the petrochemical complex that will be installed at San Lorenzo by a group of US companies, it has been estimated recently that the demand for synthetic and natural rubber in Argentina will be 44,000 tons this year, 51,000 tons next year, and 59,000 tons, 68,000 tons and 75,000 tons respectively in 1963, 1964 and 1965.

'Well, he'll say to me "cleanliness is next to godliness" just once!' — 529

DIXIE 45 is a general purpose, low cost furnace black now manufactured in the U.K. Possessing an unusual combination of the high modulus of HMF blacks; the high resilience, low hysteresis and low heat build up of SRF blacks; the smooth extrusion characteristics and low die swell of oil based blacks.

DIXIE 60 (HAF Black) processes easily and gives high resistance to abrasion and flex-cracking. Dixie 60 is now manufactured in the U.K. to the same high standard of uniformity and quality maintained by its American counterpart over many year.

DIXIE 70 (ISAF Black) is the latest addition to the range of Dixie Blacks now being manufactured in the U.K. Ideal for toughest treads, maximum mileage tyres and for gruelling high speed highway operations.

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DIXIE 60

DIXIE 70

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American Liaison and Service Branch: British Anchor Chemical Corporation, 366 Madison Avenue, New York 17, N.Y.

Licence for Polydienes

SHELL'S 'OVERALL STRONG PATENT POSITION' IN UK

A LICENCE for the manufacture and marketing of polydiene synthetic rubbers in the UK has been granted to Shell Chemical Co. Ltd. by Goodrich Gulf Chemicals Inc. of Cleveland, Ohio.

Shell already holds licences under patents held by Professor Karl Ziegler of Germany to use catalysts developed by him for the manufacture of polybutadiene and polyisoprene rubbers.

Shell claims that it now holds an 'overall strong patent position' in this field in the UK which contributes to the consolidation of its plans, as announced in March last year (*RPW*, March 26, 465), for the large-scale production of polydiene synthetic rubbers in the UK.

Site-breaking is scheduled to commence this year at Carrington, and the polydiene plant is expected to come on stream in 1963. Both polyisoprene and polybutadiene will be produced.

The butadiene required will be obtained from the C_4 fraction in the present Carrington scheme, but it is not disclosed whether the isoprene will be prepared at Carrington, piped from Stanlow, or obtained from some other source.

The first European producer of polybutadiene is expected to be Chemische Werke Hüls, who will be producing market development quantities of the rubber this spring.

And in USA:

A report from New York says that the Shell Chemical Co., in a full page advertisement in the 'New York Times' on March 21, announced full-scale production of Shell isoprene rubber. The company said this year Shell Chemical can produce over 40m. lb. of polyisoprene. Leading trade sources said that Shell was offering oil-extended polyisoprene at 24.1 cents per lb., delivered Akron. They added that the New York rubber futures market declined by ½ cent. per lb. on this news.

On the London market, when New York advices came in much lower than had been expected, the market, already very quiet, became a nominal affair temporarily on the withdrawal of bids and offers.

Blue Peter Newcomer

A new retread is introduced this week by Blue Peter Retreads, of Basingstoke. Called 'Suretread', it is being produced in precisioned moulds specially designed for bead-to-bead tyre retreading.

In the vulcanizing process, water pressure at 250 psi is used instead of conventional compressed air at 100-150 psi. This high pressure, coupled with the hot water thermostatically controlled at 185°F., enables the use of excessively fast compounds halving the cure time. The casing is thus subject to heat for the least possible period of time.

The retread is said to be easy steering and silent running, with the traction of a premium priced tyre.

Anchor's New Chairman

Frank Savaage has been appointed chairman of the Anchor Chemical Co. Ltd. and joint managing director.

T. Clyde Hewlett has been appointed joint managing director.

Prior to these appointments Mr Savaage was managing director and Mr Hewlett export director of the company.

Distillers and Xylonite

H. H. Woolveridge has been appointed to the board of the British Xylonite Co. Ltd. as the nominee of The Distillers Co. Ltd., whose £13m. bid for British Xylonite was recently declared unconditional.

Mr Woolveridge is chairman of the Distillers Plastics Group, and a member of the main board of the company. He is the newly appointed president of the British Plastics Federation, as reported elsewhere in this issue.

British Xylonite will continue to operate as a separate company.

Distillers comment that the experience of the company in the techniques of extrusion, calendering, moulding and fabrication of plastics materials will provide it with what will amount to a large reinforcement of its technical service organization, and enable it to speed up the development of new uses for the plastics materials which it manufactures.

The company adds that 'closer collaboration between the two organizations in the fields of product and customer research, buying and export selling will produce economies in operation and greatly strengthen the position of Distillers in the rapidly developing plastics industry'.

Curing Porosity in Rubbers

A POWERFUL desiccant which is said to prevent porosity caused by the presence of moisture during the processing of natural and synthetic rubbers, has been introduced by John and E. Sturge Ltd. (Wheeleys Road, Birmingham 15). It has been developed in conjunction with the Rubber and Plastics Research Association of Great Britain and is being manufactured by Sturge at Birmingham.

Porosity in natural and synthetic rubbers is an old problem, but the development of RAPRA's fluid bed method of heating rubber made the solution a matter of vital importance. Intensive investigations by the association proved that moisture was the main cause of porosity, and led to the development of the desiccant.

The desiccant, which is known as Caloxol, is a specially-prepared 3:1 dispersion of Sturge calcium oxide in acid refined mineral oil. It is a thick, odourless, paste which can be poured at room temperature, and is claimed to have good storage life without pick up of atmospheric moisture. Caloxol is said to be non-scorching when used with a wide range of conventional accelerators, and it can be incorporated without difficulty into rubber compounds. The addition of 3-8 parts of Caloxol per 100 parts of rubber or polymer is recommended.

One general purpose grade is available at present — packed in steel 50-kilo drums — but it is expected that others will be developed, with different concentrations of calcium oxide and different dispersing media, following customer evaluation.

Beetle DMC Price Cut

BIP Chemicals Ltd. has reduced the price of its whole range of Beetle dough moulding compounds with effect from April 1. The company says that the cut is due to increased orders and improved production facilities, together with a reduction in the price of raw materials.

The price reduction of some grades is approximately 20%. Type A has been reduced from 3s. 6d. to 3s.; type B 3s. 8d. to 3s. 2d. and type C 2s. 6d. to 2s.

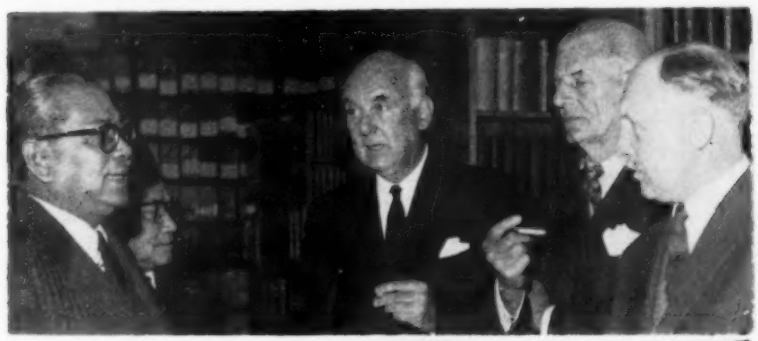
Severnside Contract

William Boby and Co., of Rickmansworth, Herts., has been awarded a £13,000 contract by I.C.I. for the supply of a dealkalization-base exchange plant to the company's Severnside complex.

Malayan PM at Welwyn

VISIT TO NRPRA LABORATORIES

THE Prime Minister of Malaya, Tengku Abdul Rahman Putra Al-Haj, visited The Natural Rubber Producers' Research Association at Welwyn Garden City on March 20.



(Top, left to right) **The Prime Minister of Malaya with H. E. Tengku Ya'acob, High Commissioner for Malaya in the UK, R. B. Carey and H. B. E. Hake (both members of the Co-ordinating Advisory Committee of the Malayan Rubber Fund Board) and Dr L. Bateman (Director of NRPRA).** *(Bottom)* **Chatting with scientists after examining latex-forming cells through the electron microscope on the left**

The Prime Minister inspected the laboratories of the association which is engaged in research work to increase the usefulness of natural rubber to industry and extend its applications. The present staff numbers about 60 graduates and those of similar status and about 80 assistants and ancillary staff. A broad range of fundamental and applied research extends into botany, biochemistry, several branches of chemistry, physics, engineering and rubber technology.

The association and its sister units —The Rubber Research Institute of Malaya and The National Rubber Bureau — are an example of Commonwealth collaboration in science, technology and promotional work.

The Malayan Rubber Fund Board provides for research and development work on natural rubber $12m. (Malayan) (£1.4m.) annually from a cess on rubber exports. Other rubber producing Commonwealth countries also contribute.

Malaya now produces more natural rubber than any other country and last year achieved a record total of approximately 710,000 tons, more than a third of the world's total supply.

In the Prime Minister's party were: H. E. Tengku Ya'acob, High Commissioner for Malaya in the UK; Tengku Ja'afar, Counsellor and Trade Commissioner at the High Commission; Yeo Beng Poh, Commercial Secretary to the High Commissioner for Malaya in the UK, and F. Sullivan, the Prime Minister's Press Secretary. They were welcomed by Dr L. Bateman, Director NRPRA, and E. Jago, Vice-Chairman NRPRA and NRB, the eminent scientists Sir Harry Melville, Secretary of the Department of Scientific and Industrial Research, and Sir Eric Rideal, former Vice-Chairman of the NRPRA, H. B. Egmont Hake and R. B. Carey, all members of the Co-ordinating Advisory Committee of the Malayan Rubber Fund Board.

Britain's Biggest Rubber Plantation

During his tour the Prime Minister saw Britain's biggest 'rubber plantation' — 50 young trees in the NRPRA's greenhouse. Latex from these trees is being used in studies which throw light on how rubber is formed in the tree. He also examined latex-forming cells under the electron microscope which can give a magnification of over 160,000 times.

Other research projects covered during the visit included tests on skid resistance and other factors governing the efficiency of tyres, methods of improving rubber to withstand deterioration due to ozone attack, the evaluation of the new forms of Superior Processing Rubber, which Malaya is now exporting in quantity, and work on designing rubber components for specific engineering purposes.

BPF's NEW PRESIDENT

H. H. WOOLVERIDGE, a director of The Distillers Co. Ltd., is the new president of the British Plastics Federation in succession to C. H. Glassey. The election took place at the annual general meeting (*RPW*, March 18, 413).

Joining Distillers in 1925 on the chemical side, Mr Woolveridge played an active part in the formation of the company's plastics group, of which he is now chairman. In addition to being a director of the companies comprising this group, he is also on the boards of three companies in the Distillers' chemical group.

Born in London, Mr Woolveridge is a Freeman of the City of London and was recently elected Renter Warden of the Worshipful Company of Horners.

David Radford (Ekco Plastics) and F. Walls (I.C.I.) remain chairman and vice-chairman of the Federation respectively.

The members of BPF Council for 1961/62 are: R. P. Anderson, G. S. Bache, S. R. Badley, D. H. Balfry, S. Baxter, H. V. Blake, D. H. Brett, N. Browne, L. R. Cornelius, G. V. Cox, E. A. Davis, K. R. Dodd, J. L. Fergus, A. Gundry, A. W. Hall, T. Harland, D. A. Harper, H. F. W. Head, A. A. Heath, S. Holmes, S. Hope, R. W. Lowe, E. A. O. Mange, D. G. Owen, B. S. Parkyn, J. A. Pentecost, A. W. Rawe, E. J. P. Reynolds, G. G. Ritchie, P. Russell, A. B. Scotson, P. Smith, C. R. Todd, J. S. Walker, M. B. Warbreck-Howell, E. J. Westnedge, H. White, R. H. Wilby, C. G. Wilde and A. W. Wilson.

Past chairmen — ex-officio on the Council: P. A. Delafield, H. W. Graesser-Thomas, H. V. Potter, A. E. Skan and W. Chas. Waghorne. Co-opted: H. A. Collinson, C. S. Dingley, G. W. Hodds and A. Renfrew.

FBRAM Direct Membership Scheme

ALREADY REPRESENTATIVE OF 85-90% OF RUBBER INDUSTRY

AT a meeting of the Council of the Federation of British Rubber and Allied Manufacturers, held at the Berners Hotel, London, on Thursday (March 23), a further list of applications for membership of the Federation under the new direct membership scheme was submitted and approved. This brings to 164 the total number of firms and their subsidiaries who will be members when the new arrangements come into force on April 1. The names of these firms are given on this page in alphabetical order.

The Director explained at the meeting that, although there were some noticeable and regrettable gaps in the list, the new membership already represented between 85% and 90% of the rubber manufacturing industry, and he hoped that this figure would be still further improved in the course of the year.

The Council also accepted the application of the Rubber and Plastics Footwear Manufacturers' Association for re-entry into the Federation. Two new associate members were elected: William Mills Ltd., tyre mould makers, and Robinson Bros. Ltd., chemical manufacturers.

Meanwhile the Federation has moved its offices to 19/20, Berners Street, London, W.1, the telephone numbers, Museum 2671 and 0268, remaining unchanged.

FBRAM ORDINARY MEMBERS

A.E.I. Plastics (Aldrilge) Ltd.; J. Allen Rubber Co. Ltd.; Avon Footwear Sales Ltd.; The Avon India Rubber Co. Ltd.; J. E. Baxter and Co. Ltd.; Barrow, Hepburn and Gale Ltd.; B.B. Chemical Co. Ltd.; Belpar Rubber Co. Ltd.; Bergougnan Tyre Co. Ltd.; Bintex Ltd.; Boro Rubber Co. (1912) Ltd.; Britannia Rubber (Installations) Ltd; Britannia Rubber and Kamptulicon Co. Ltd.; The British Bata Shoe Co. Ltd.; The British Ebonite Co. Ltd.; British Moulded Hose Co. Ltd.; British Recovered Rubber and Chemical Co. Ltd.; British Paints Ltd.; B.T.R. Industries Ltd.; John Bull Rubber Co. Ltd.; Cannon Rubber Manufacturers Ltd.; Capon Heaton and Co. Ltd.; Castle Rubber Co. Ltd.; The Chichester Rubber Co. Ltd.; Henry A. Cole and Co. Ltd.; Coopers Plastic Foams; Corrance and Yuill Ltd.; P. B. Cow and Co. Ltd.; P. B. Cow (Industrials) Ltd.; P. B. Cow (Proofings) Ltd.; P. B. Cow (Special Products) Ltd.; Davies Tyre Co. Ltd.; Dewey and Almy Ltd.; Dexine Rubber Co. Ltd.; R. and J. Dick Ltd.; Dunlop Rubber Co. Ltd.; Dunlop Footwear Ltd.; Dunlop Sports Co. Ltd.; Electric Hose and Rubber Co. Ltd.; Empire Rubber Co.; Evode Ltd.; Evomastics Ltd.; Expanded Rubber Co. Ltd.; Expanded Plastics Ltd.; Expandite Ltd.; T. and W. Farmiloe Ltd.; J. H. Fenner and Co. Ltd.; Ferguson Shiers Ltd.; Firestone Tyre and Rubber Co. Ltd.; Flexicon Ltd.; P. Frankenstein and Sons (Manchester) Ltd.; J. G. Franklin and Sons Ltd.; Gandy Ltd.; Genefoam Ltd.; The General Electric Co. Ltd.; The Goodyear Tyre and Rubber Co (GB) Ltd.; Greengate and Irwell Rubber Co. Ltd.; Grovewell Ltd.; Guide Bridge Rubber Co. Ltd.; The Hairlok Co. Ltd.; James Lyne Hancock Ltd.; Harboro Rubber Co. Ltd.; Hatcham Rubber Co. Ltd.; Hazel Grove Rubber Co. Ltd.; C. E. Heinke and Co. Ltd.; The Hertfordshire Rubber Co. Ltd.; Heston Rubber Co. Ltd.; Heston Rubber Products Ltd.; The Huntingdon Rubber Co. Ltd.; Hytex Ltd.; India Tyre and Rubber Co. Ltd.; Ioco Ltd.; Kautex Ltd.; Sam Kay Rubber Co. Ltd.; Kay Brothers Plastics; Kelly-Springfield Tyre Co. Ltd.; Kelsey Industries Ltd.; Lafotex Ltd.; Larkhill Rubber Co. Ltd.; Latex Surgical Products Ltd.; Lea Bridge Rubber Works Ltd.; Lee-Healey Co. Ltd.; Leyland and Birmingham Rubber Co. Ltd.; Lintafoam Ltd.; Lintafoam Industries Ltd.; London Rubber Co. Ltd.; Long and Hambly Ltd.; Joseph Lucas (Electricals) Ltd.; M.A.M. Rubber Manufacturing Co. Ltd.; George MacLellan and Co. Ltd.; Manchester Garments Ltd.; J. Mandelberg and Co. Ltd.; J. Mandleberg and Co. (Rubber) Ltd.; J. Mandleberg and Co. (Dyers) Ltd.; Metalwood Putty and Mastics Ltd.; Michelin Tyre Co. Ltd.; Minnesota Mining and Manufacturing Co. Ltd.; Morris Rubber Industries Ltd.; Morgan Ebonite Co. Ltd.; David Moseley and Sons Ltd.; Moulded Rubber Products Ltd.; Murray and Ramsden Ltd.; Nordac Ltd.; North British Rubber Co. Ltd.; Northern Rubber Co. Ltd.; Onazote Insulation Co. Ltd.; The Outra Belting and Rubber Co. Ltd.; Palmer Aero Products Ltd.; Peradin Rubber Co. Ltd.; Perrite Ltd.; Phillips Rubber Soles Ltd.; Phillips Patents Ltd.; Phillips Rubbers (Manufacturing) Ltd.; Phoenix Rubber Co. Ltd.; Pirelli Ltd.; Poppe Rubber and Tyre Co. Ltd.; Premier Bitumen and Asphalte Co. (1959) Ltd.; Radburne and Bennett (Rushden) Ltd.; Redfern Holdings Ltd.; Redfern's Rubber Works Ltd.; Redfern's (Bredbury) Ltd.; Regent Tyre and Rubber Co. Ltd.; Richborough Rubber Works Ltd.; Alfred Roberts and Sons Ltd.; Rotunda Ltd.; Rubber Bonders Ltd.; Rubber Company of Scotland Ltd.; Rubber Flooring Ltd.; Rubber Improvement Ltd.; Rubber Latex Ltd.; Rubberlines (Hyde) Ltd.; Rubberware Ltd.; Runnymede Rubber Co. Ltd.; Sealanco Ltd.; Z. Sebes (Rubber) Ltd.; Secomastics Ltd.; Semtex Ltd.; The St. Albans Rubber Co. Ltd.; Silent Channel Co. Ltd.; Silvertown Rubber Co. Ltd.; Slazengers Ltd.; Sorbo Ltd.; The South Wales Brattice Cloth and India Rubber Co. Ltd.; George Spencer Moulton and Co. Ltd.; The Stalybridge Rubber Co. Ltd.; G. Strauss and Sons Ltd.; Surridge's Patents Ltd.; Sussex Rubber Co. Ltd.; Turner Brothers Asbestos Co. Ltd.; Tyres (Scotland) Ltd.; Tyresoles Ltd.; US Rubber International (GB) Ltd.; Veedip Ltd.; Vitafoam Ltd.; Vitapol Ltd.; Volcrepe Ltd.; Waltham Rubber and Plastics Ltd.; Willesden Rubber Co. Ltd.; William Warne (Holdings) Ltd.; William Warne and Co. Ltd.; Windmill Rubber Co. Ltd.; Woodite Co. Ltd.; The Woodville Rubber Co. Ltd. and The Woodville Rubber Co. (Fine Products) Ltd.

FBRAM ASSOCIATIONS IN MEMBERSHIP

British Rubber and Resin Adhesive Mnfrs. Assn.; British Assn. of Balata Belt Mnfrs.; British Rubber and Plastics Belting Mnfrs. Assn.; British Cellular Rubber and Plastics Mnfrs. Assn.; Assn. of British Ebonite Mnfrs.; British Rubber Flooring Mnfrs. Assn.; Food Jar Rings Assn.; Rubber and Plastics Footwear Mnfrs. Assn.; British Wrapped Rubber Hose Mnfrs. Assn.; British Rubber Hot Water Bottle Mnfrs. Assn.; British Latex Foam Mnfrs. Assn.; British Mechanical Rubber Mnfrs. Assn.; British Moulded Rubber Hose Mnfrs. Assn.; Plant Lining Group; Rubber Proofers Assn.; Screw Stopper Makers Assn.; Sealant Mnfrs. Conference; British Seamless Rubber and Plastics Mnfrs. Assn.; The Sole and Heel Mnfrs. Assn.; Rubber Surgical Equipment Mnfrs. Assn. and Tyre Mnfrs. Conference Ltd.

FBRAM ASSOCIATE MEMBERS

Akron Standard (Engineers) Ltd.; Anchor Chemical Co. Ltd.; Bone Brothers Ltd.; David Bridge and Co. Ltd.; John Bright and Brothers Ltd.; British Enka Ltd.; British Geon Ltd.; British Nylon Spinners Ltd.; Cabot Carbon Ltd.; Columbian - General Black Ltd.; Cromer Ring Mill Ltd.; Dewhurst and Partners Ltd.; Du Pont Co. (UK) Ltd.; Durham Raw Materials Ltd.; Esso Petroleum Co. Ltd.; Excel Mould and Tool Co. Ltd.; The Geigy Co. Ltd.; R. W. Greeff and Co. Ltd.; Hubron Rubber Chemicals

Continued on page 484

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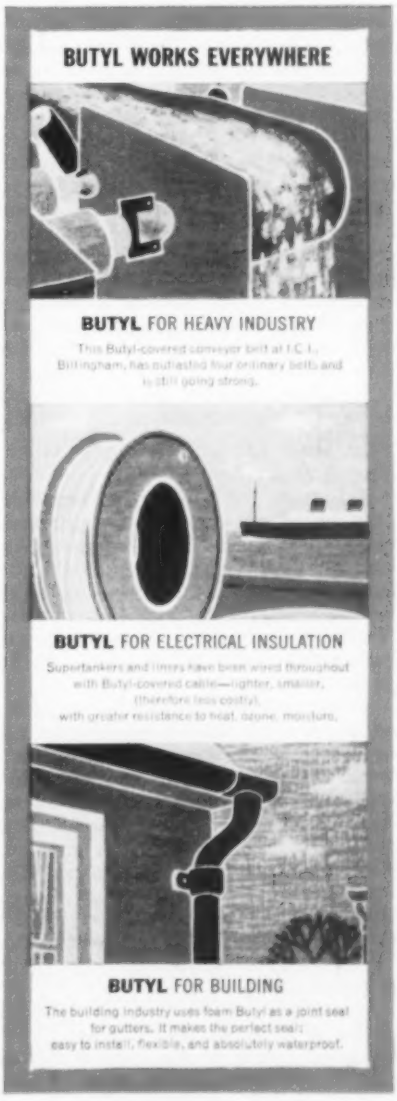
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VIEWS and REVIEWS

AN important field of study for most branches of the polymer industry is pigmentation, and it happens that recent European literature has a number of papers on the subject.

Pigments and Paints for Plastics

Under the title, 'The Colouring of Plastics', Dr E. Zalan contributes a general introduction to the subject in *L'Officiel des Matieres Plastiques* for February 1961, No. 78, pp. 160-166.

Dealing first with the point of view of the manufacturer of plastics articles, Dr Zalan discusses five broad methods of colouring: buying the materials already coloured from the supplier of raw materials, making such starting materials oneself, using paste concentrates or masterbatches, dry colouring, and the use of inks.

Concentrates and masterbatches have advantages, but sometimes the essential of good dispersion is not secured, because of the presence in the remainder of the mix of incompatible substances, and, in an attempt to improve dispersion by means of additives, important physical properties can be debased.

Dry mixing is commonly used for polystyrene, pvc, and polyolefines, and consists essentially in coating the particles of the basic resin with the pigment before the main process of moulding, extruding and so on.

Inks are generally used, of course, for coloured, decorative designs on plastics articles, particularly films. The formulation of a good ink is not easy; it should dry rapidly but not too hard or it will impair the feel of the film, while on the other hand it must not become soft and sticky by absorbing plasticizer, it should have no offensive residual odour, and the pigment should not 'run'.

Polythene films are often treated with oxidizing agents before printing in order to ensure adhesion of the ink, but other methods are being developed.

Properties of a Good Pigment

The analytical part of the discussion then deals with the need for homogeneity, uniformity, and absence of side-effects during processing, making some rather obvious points on these matters, and concludes with a consideration of the requirements of the final customer — cheapness, attractive appearance, durability, and safety. Finally, the author considers the general principles governing the choice of pigments which his analysis has indicated.

If the very best pigment is required, to resist, say a temperature of 300°C. for 30min., the user is limited to carbon black, titanium dioxide, zinc oxide, cadmium yellows and reds, iron oxide, cobalt blue, or among the organics, anthraquinones, aniline blacks, and phthalocyanines. For somewhat less arduous service, there are the benzidine colours and the metallic azo compounds. Progress is being made by Bayer, Ciba, and Du Pont, and although the new pigments being offered by these companies are expensive and sometimes difficult to disperse, they are attractive and economical because they are in the group of yellows and reds and only small proportions are needed.

Progress in the field of new polymers is making the choice of pigments more difficult. For example, certain pigments found in the past to be quite stable, have proved disappointing in some of the new polyesters because of reaction with the peroxides, and at high temperatures polyamides can act as reducing agents, while polycarbonates demand moulding temperatures much higher than needed for the older plastics. In short, each case must be tested on its merits under the conditions in which it is processed and used.

'Cinquasia' Pigments for Vinyls

On pages 29-32 of *Industries des Plastiques Modernes* for November 1960, R. H. Zabel and E. C. Botti of Du Pont describe the properties of three pigments derived from quinacridine. The discovery of the blues and greens based on phthalocyanine resulted in the setting up of a new standard of pigmentation and it is claimed that the Du Pont 'Cinquasia' pigments do the same for the reds and violet.

'For the vinyl resins, the reds "Cinquasia" Y and B, as well as the violet "Cinquasia" R exhibit a remarkable intensity of hue in the pastel tones, possess an excellent fastness to light in strong or weak concentrations, have an excellent resistance to crocking, to migration, to acids, alkalis, and heat. Similar results have been obtained in plastisols and organosols, and following the initial trials, the same satisfactory behaviour is expected in extruded pvc'.

The azo pigments, that is to say those having no metallic radical, are with few exceptions limited in vinyl resins because they bleed. But the precipitated azos are widely used in vinyls although they are almost entirely confined to the red end of the spectrum and all have disadvantages, some in light-fastness, some in susceptibility to acids and bases.

The non-azo colours comprise a large number of different chemical types. The acidic or basic lakes are not recommended for vinyls because they bleed and are not very fast to light. Some of the vat dyes can be used in vinyl resins, some are not satisfactory; many are difficult to disperse and are rather dull in hue. Practical trials are essential. The phthalocyanine pigments are generally good.

The authors conclude that: 'The appearance of the red and violet "Cinquasia" pigments is a definite step forward in the technology of colouring, thanks to their excellent qualities of light-fastness, heat-resistance, chemical resistance, as well as the absence of migration and crocking, to which must be added the brightness of their colour. . . .'

The paper has an appendix of methods of test and gives the results of extensive investigations based on them and supporting the above claims.

Pearls

'Thanks to its beauty, natural mother-of-pearl provides us with a material which, since antiquity, has been used for jewellery and other small articles of a decorative character', says Dr Heinz Hunsdiecker in an article called 'Making Mother-of-Pearl Articles' in *L'Officiel des Matieres Plastiques* No. 77, for January 1961, pp. 53-4. 'It is therefore not surprising that there have been many attempts to imitate its remarkable optical effects. The chemical industry, with the development of plastics products, has stimulated researches in this field and it can be said that they have been crowned with success'.

COMMENT ON SCIENTIFIC AND INDUSTRIAL MATTERS

by **F. C. JENNINGS**

Chemical and physical examination of 'essence of pearl' have shown that the unique optical appearance of pearls is brought about by reflection from stratified crystal lamellae coupled with a high refractive index. Such a result can, of course, be achieved artificially and 'synthetic pearl essence' is now commercially available, based probably on crystalline bismuth oxychloride or acidic lead phosphate.

If the right type of crystal is successfully incorporated into a plastics matrix in such a way that the main reflecting surfaces of the crystal are almost parallel with the surface of the article being made, a reflecting, shining, glistening, pearly appearance is produced. If this parallel arrangement be broken or cut at a small angle to expose successive lamellae, the typical appearance of mother-of-pearl nacre is obtained.

Orientation by Centrifugal Force

It is possible to make plastic pearl by suspending suitable crystals in a liquid resin, applying a centrifugal force to orient the crystals, and then to set the polymer, for example, by condensation or polymerization, so that the crystals are fixed in the oriented position. Further, by using an internal obstacle in the liquid resin during centrifuging, sufficient non-homogeneity can be brought about to produce nacre instead of pearl.

It should be noted that in subsequent fabrication, especially when high temperatures are employed as in extrusion, the pearl structure may be disoriented and either completely destroyed or changed to nacreous.

It is possible to bring about crystal orientation in some plastics without resort to centrifuging, for example, in the blow-moulding of polythene or the calendering of pvc, but perhaps the simplest of all methods is by painting the surface of the plastics article with a thin coating of a varnish containing the scintillating crystals.

Varnishing Plastics

Some plastics articles need lacquering in order to secure some types of surface decoration. This operation raises its own problems, the more obvious being such things as the possible effect of the varnish medium on the plastics material, the less obvious being the effects on any internal stresses set up during moulding or on the possibility of re-using defective material. These and other problems are considered by Dr C. F. Spiers in a paper on page 55 of the November 1960 issue of *Industrie des Plastiques Modernes*.

Dr Spiers considers the problems in three ways: those inherent in the composition of lacquers and varnishes, those arising from the nature of the plastics materials being varnished, and those concerned with the techniques of lacquering. Of course, these classes overlap. For instance, while the kind of solvent used in a varnish must be chosen with due regard to the nature of the plastics material on which it is to be used, it is not always possible to generalize because the method of application can readily influence the result — spraying, brushing, or dipping may produce entirely different effects.

Articles containing re-worked scrap often create difficulties in varnishing because of the incorporation of mould-parting agents and the like, so that tests on virgin material can be misleading. Similarly, the blooming of plasticizers can impair a surface varnish.

Stresses at the Injection Point

'Another point deserving attention is that some plastics materials, among which are the polyacrylates and polycarbonates, in contact with certain solvents which do not actually dissolve the plastics, bring about the formation of cracks which can actually disrupt the article. . . . Stresses can exist in a moulded article, particularly at the injection point, without being visible to the naked eye, though polarized light can reveal them at once. Such stresses, on contact with even the most carefully chosen varnish or solvent, can produce large numbers of cracks. . . . Often these stresses can be relieved by judicious heating before varnishing and their disappearance confirmed by testing with polarized light. On the other hand, in the complexes plastic-plastic, plastic-metal, plastic-wood, stresses can exist which are brought to light only by the formation of cracks after lacquering, because of the different thermal expansion coefficients of the materials concerned. These stresses can also cause disruption of the article'.

Drying of the varnish must be carefully studied as there is considerable variation between the needs of one plastics material and another, and even between one shape and another. In varnishing objects having deep depressions, it is often necessary to dilute an otherwise suitable varnish so as to avoid filling them with excess varnish. Each method of application, by brush, roller, dipping, spraying, needs careful trial before final adoption — general rules cannot easily and safely be formulated.

Varnishes protective against ultra-violet light and other deleterious agencies can be made. The author asserts that at present no satisfactory varnish or method of varnishing is known for polythene or polypropylene, though a surface-coloration process can yield interesting results.

Polyvinyl Acetate Dispersions

I found a paper by W. Pöge in *Plaste und Kautschuk*, Vol. 8, No. 2, for February 1961, called 'The Attack on Polyvinyl Acetate Dispersions by Moulds and its Suppression' to be very interesting. Fungoid growths were occasionally found, given favourable conditions, on the wet dispersion but never on films deposited from the pure dispersion unless used as coatings for materials (*e.g.* wood and paper) which are themselves susceptible to mould growth. Naturally some additives will increase the attack by fungi of one sort and another, but in this investigation it was the pH which was found to have the most marked effect, an alkaline state greatly favouring mould growth, probably by reason of the destruction of the acetate by saponification.

From the list of fungicides investigated, the most effective were found to be tributyl tin hydroxide, sodium silicofluoride, and chloracetamide.

Anti-corrosion Paints

The same journal also carries an interesting survey on pp.106-8 on 'Modern Paints for Protection Against Corrosion' by H. J. Klingner. It is in itself too concentrated a paper to warrant abstracting here but deals particularly well with primers, chromate bases, quick-drying paints (including chlorinated and cyclized rubbers), and epoxy and urethane lacquers.

CHARLES JENNINGS.

MEN and MATTERS

A Review of People and Events

by Peter Richards

IN 1882 a certain Dr Godfrey L. Cabot began manufacturing carbon black in Worthington, Pennsylvania. The business prospered until now the name Cabot is one of a handful which are synonymous with carbon black to polymer people throughout the world.

Dr Cabot is not only still alive — he is as healthy as the business he founded. And he celebrated his 100th birthday recently in Boston, surrounded by more than 50 members of his family, and Cabot directors and their wives. I understand that literally thousands of telegrams and letters of congratulation poured into his home from all over the world. He read all these messages — including one from the President and one from his old friend Eisenhower — without the aid of glasses.

Among many gifts was a scroll signed by employees in USA, Argentina, the UK, Canada, France, Italy and Australia.

Learning to Fly at 54

Dr Cabot has led a varied life inside and outside the industrial field. He is a great philanthropist, and, after learning to fly in 1915 at the age of 54, he conducted the first successful experiment in picking up burdens from aircraft in full flight when he 'collected' an oil drum from Boston Harbour in his seaplane. He patrolled the harbour in this plane from 1917 to 1918 when he was in the United States Naval Reserve Force.

His honours are as numerous as his years. They range from Elder Statesman of Aviation — elected in 1955 by the National Aeronautic Association of USA — to Fellow of the American Academy of Arts and Sciences.

First Time View

One of a geologist's headaches is repairing satisfactory thin sections of certain brittle rocks and sediments for microscopic examination. Recent experiments at the Royal School of Mines have shown that the problem can be solved by impregnating the specimen with a polyester resin.

In one method the sample and a Bakelite resin (DSR 19098) are heated to about 75°C. in an ordinary laboratory oven and held at this temperature for about 12 hours, by which time the resin acquires a treacly consistency. The temperature is then raised to about 125°C. and held for a further 12-24 hours, when the resin becomes tough and rubbery — and after cooling it is usually hard enough to be cut without crumbling.

This technique is said to have made it possible to view certain materials under the microscope for the first time.

Sweeping the Board

E. S. Tarrant, a general line salesman of the Goodyear Tyre and Rubber Co. South Eastern division, has been awarded the company's premier award for salesmanship for 1960. This is the A. S. Bishop award, which is designed to place on permanent record each year's outstanding accomplishment by a Goodyear salesman. The award is open to competition by members of the Goodyear Sales Organization covering all products.

E. S. Tarrant (*top left*) **receives the A. S. Bishop award from A. S. Thomson (manager of Goodyear's replacement sales division) and G. A. Packham** (*bottom left*) **receives the eagle trophy from J. Lunt of sales development**

The company's South Eastern division (whose headquarters are at Holloway Road, London, N.7, under the management of S. Davies) received the Hazlett Shield for its work in 1960 — this award is made to the division completing the best all round job each year.

Goodyear must be really on their mettle in the South East, as the eagle trophy, awarded each half year to the best sales district in the organization, also went to the division's Watford District, managed by G. A. Packham.

Buyer of 2m. tons Retires

A man who has bought an estimated 2m. tons of rubber for Dunlop, retires from the company on March 31 after 30 years' service. He is R. A. Pleace, aged 65, who joined Dunlop in 1930 as a rubber buyer after 18 years' experience in the London Rubber Market. After helping to organize rubber purchasing at Fort Dunlop, Birmingham, he went to Saharganj, India, to explore the markets and open up rubber buying connexions in Burma and South India. Later he was closely concerned with the setting up of the Dunlop Purchasing Co., Singapore.

Mr Pleace was then appointed rubber buying manager at Fort Dunlop, spending over 20 years there before moving to London as manager of the rubber purchasing department.

Port in Polystyrene

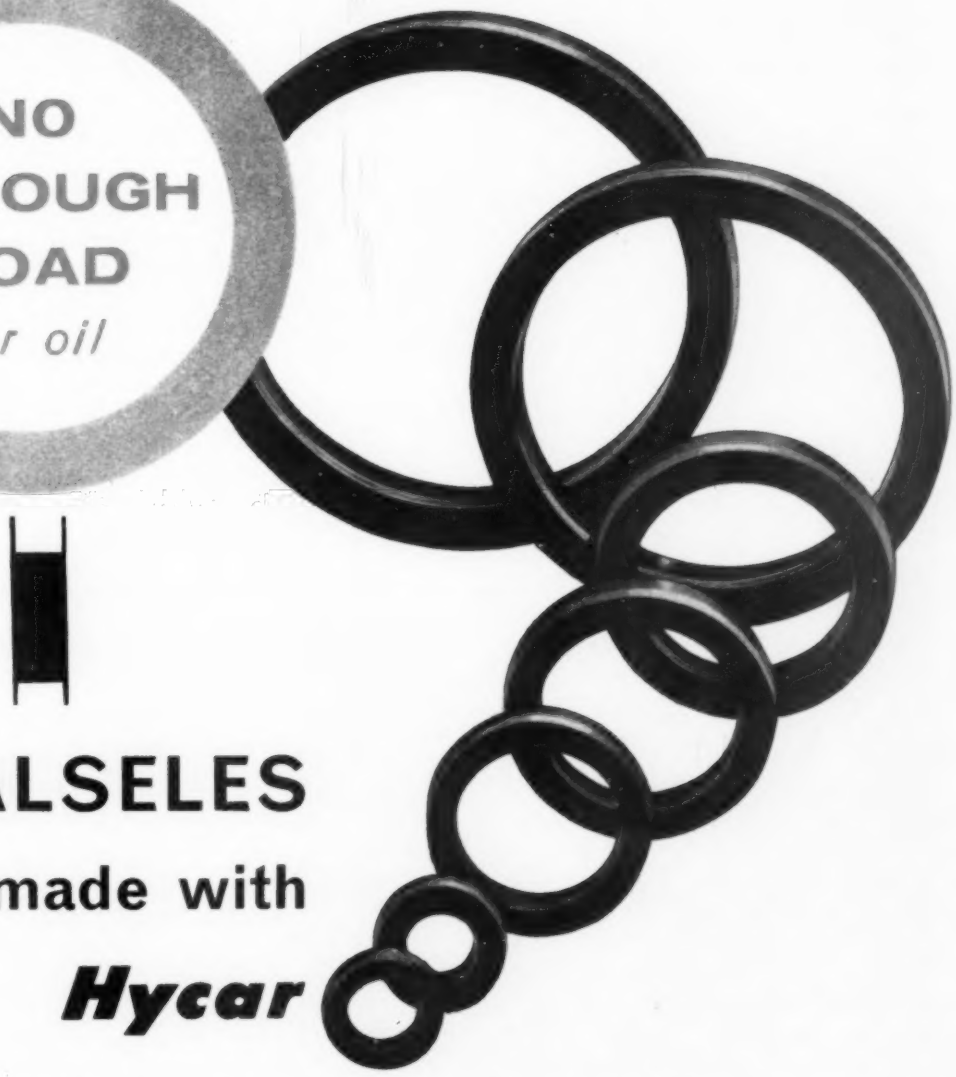
It may seem a little too much, even to someone in the industry, to take his port out of polystyrene. Nevertheless, polystyrene wine glasses are proving quite a success, and Pioneer Plastic Containers has introduced two more glasses into its Weslon Ware range this week.

Phillips Promotion

Phillips Petroleum International Corp. has elected I. L. Coffman, E. L. Gray, and J. O. Willums to vice-president positions.

Mr Coffman is assistant manager of the sales and development division of Phillips Petroleum's international

NO THROUGH ROAD *for oil*



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department in New York, and Mr Gray has been manager of Phillips Petroleum International's Panama office since June 1959.

Jan Willums, who is manager of Phillips Petroleum International's offices in Zurich, and a very well known figure in the UK and Europe, started with Phillips Chemical Co. in 1948 as technical representative in Copenhagen. He studied chemical engineering at the Oslo, Norway, Technical School, received a degree in industrial engineering from the University of Akron, Ohio, and studied technical and commercial courses at the University of Berlin. He is a member of the American Chemical Society and various rubber associations in Europe.

I. E. S. Butler has been appointed to the board of Novadel Ltd. He was formerly works manager in the company's Gillingham works

Appointments in Brief

BTR Industries Ltd. has appointed J. Lewin as materials handling engineer responsible for the development of mechanical handling techniques within the BTR Group.

* * *

Bertram White has been appointed chairman of A.. Boake Roberts and Co., as from April 1. Mr White will continue as managing director.

Polly Ester Says . . .

'Corrode — dual carriageway'

THE LEGAL ANGLE

At Your Lease's End

By a Barrister

'. . . Their range of products includes polythene kitchen utensils and containers, toys, toilet accessories and brushes. As business expanded larger premises were needed . . . a year later, 65,000 sq. ft. of additional floor space was rented at nearby Walton-on Thames'. — RPW, February 18 1961.

But what happens when that lease comes to an end? What are the chances of getting it renewed? How much will the company have to pay? And what must a tenant do in order to see that his interests are protected when his tenancy is about to terminate?

Under the 1954 Landlord and Tenant Act, all sorts of protection is given to business tenancies, provided that the tenants not only know their rights but also take advantage of the procedure prescribed by the Act. Business tenancies continue, for instance, until someone puts an end to them. A tenant can do it, but he will usually wait until he receives a notice from the landlord. If, then, he serves a proper counter-notice within the prescribed time, the landlord will only be able to evict him in certain circumstances; if he makes application to the court, the court can determine the precise terms of the new tenancy, if he cannot agree them with his landlord. But if he fails to give the appropriate counter-notice, or to make application to the court within the specified times, he will lose his rights. No court in the country has the power to extend that time; so once the rights are lost, they are gone for ever. The moral is that as soon as your lease is about to determine, the sooner you approach your lawyer, the better.

Seven Cases for Eviction

'But when can a landlord prevent you from getting a new lease at all, even if you do take the statutory steps?'

Section 30 specifies seven cases. Here, broadly speaking, they are:

(1) Where the tenant has failed to comply with his repairing covenants.

(2) Where the tenant has been persistently late in paying his rent.

(3) Where there have been other substantial breaches by the tenant of his obligations under the tenancy.

(4) Where the landlord has offered and is willing to provide reasonably suitable alternative accommodation.

(5) Where the current tenancy was created by a sub-letting, and the landlord reasonably wants to let off the place as a whole.

(6) Where the landlord wants to demolish or reconstruct the premises and cannot do it while the tenant remains in occupation.

(7) Where the landlord has acquired his interest at least five years previously, and wishes 'to occupy the holding for the purposes, or partly for the purposes, of a business to be carried on by him therein, or as his residence'.

Somewhere in Between

If, then, the landlord can satisfy the court that the tenancy comes within one or more of those exceptions, the court has no power to grant a new tenancy. But, where he fails, the court must grant one.

As for the new terms, the rent will usually go up and the remainder — repairing obligations and so on — will remain the same. Where the parties cannot agree, then the court will decide. At the hearing, the experts on both sides will do battle. The landlord's local estate agent will say that the property is worth £x per annum. The tenant's expert will say £x-y. And the chances are that the court will come down somewhere in between. There is no guarantee, of course, but that is what usually happens.

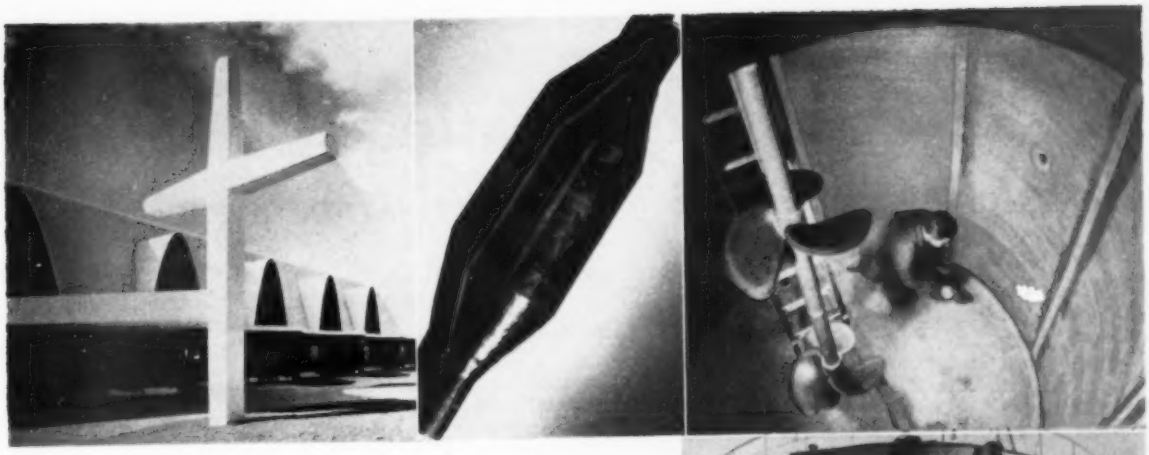
Compensation

'And suppose you don't get a new lease, will you get compensation?'

Yes — but not nearly as much as you would have received before the Act. Apart from compensation for improvements, S.37 provides that you can get twice the rateable value of the holding if you've been in the place for 14 years or more, or otherwise, just the rateable value.

'That is not much, is it?'

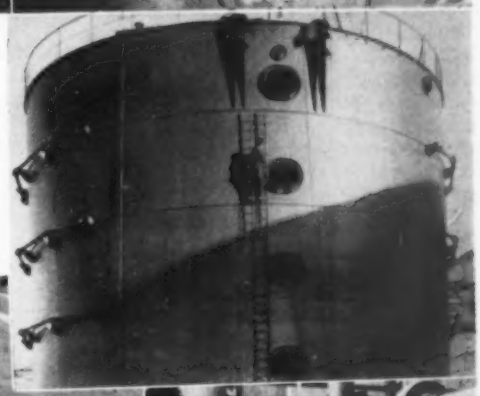
Indeed not. So the moral is clear — obtain yourself a new tenancy if you possibly can. And then, of course, if you do not want to stay, the law will not make you. You can always assign your rights, on the best terms you can get.

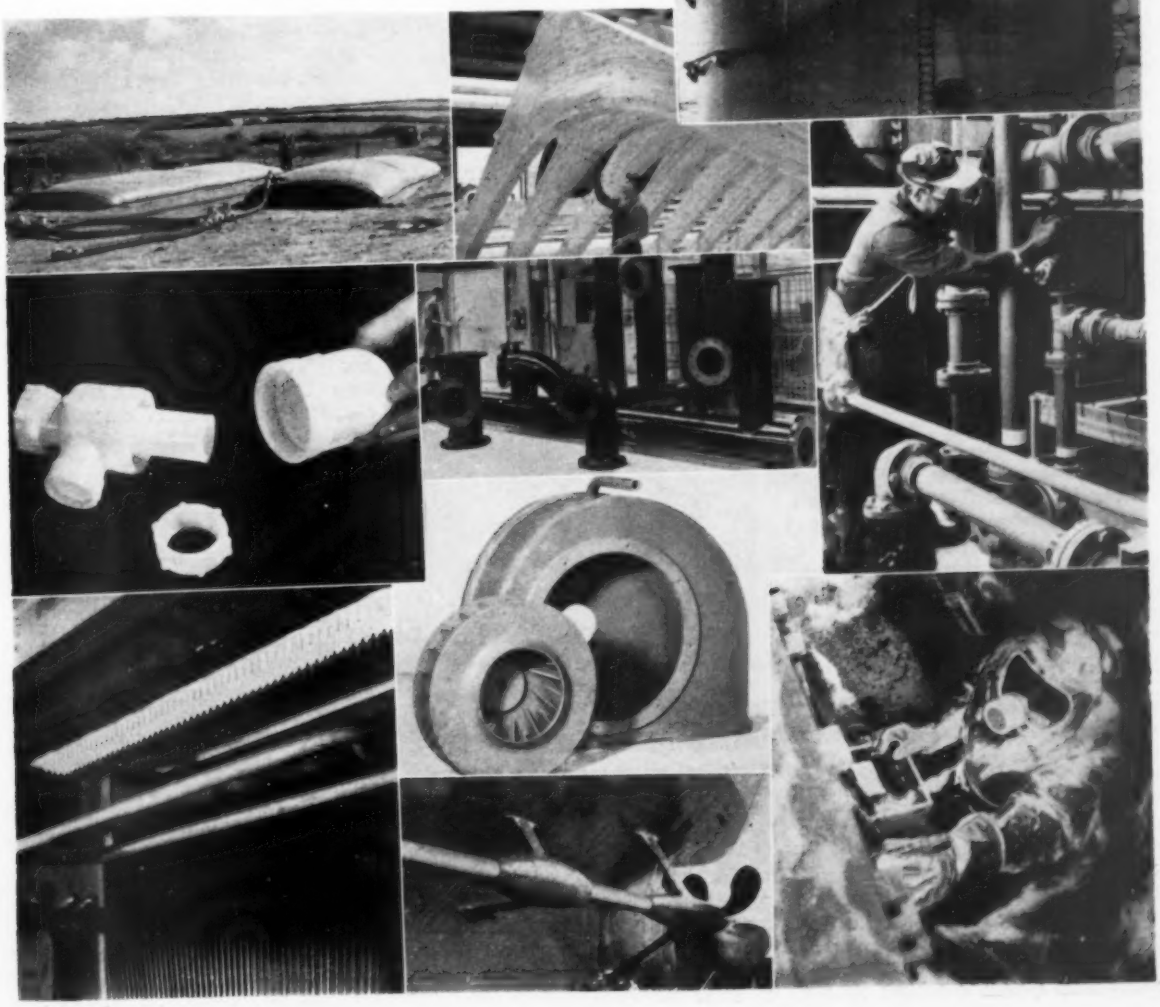


AN RPW SPECIAL FEATURE

Corrosion and Insulation

A key to the applications on this page appears on page 465





CORROSION and INSULATION

Epoxy Coatings

MANY USES ARISING FROM UNIQUE COMBINATION OF PROPERTIES

By P. A. DUNN, Ciba (ARL) Ltd.

EPOXY resins may now be fairly termed established engineering materials although only some ten or 12 years ago, these products were little more than laboratory curiosities. In the past decade there has been much activity in the field of chemical formulation, there have been developments in new techniques for using the resins, users have appreciated the possibilities of using them in new designs, and with increasing awareness of the properties and performance of epoxy resins, applications have continued to develop.

Epoxy resins, also known as ethoxyline resins, epichlorohydrin resins, or epoxides, are obtained from epichlorohydrin and a polyhydric phenol (usually bisphenol A). By variations in processing it is possible to produce resins of varying molecular weight, ranging from viscous liquids to high melting point solids. In the uncured state, they are thermoplastic with poor mechanical strength. They are converted to hard, tough, and substantially infusible materials of high molecular weight by reaction with a suitable hardener.

Hardeners

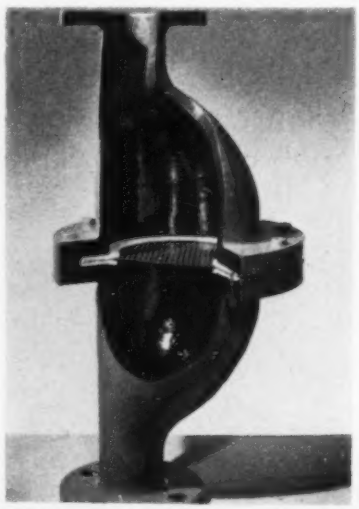
A large range of chemicals may be employed as hardeners. These include acids, alkalis and substances containing reactive hydrogen atoms, as well as certain more specialized substances. Hardeners may react as true catalysts or purely additively, or more commonly by a mixture of both processes. The type of resin and the type of hardener selected, markedly affect the properties of the cured resin system, and also affect the application viscosity of the mixture, the usable life, and the rate of cure.

The many combinations and permutations of the several basic epoxy resins and the even greater number of hardeners can be further extended by modification with solvents, plasticizers and diluents. Some diluents and plasticizers are reactive and can be combined into the final cured product. Generally, diluents and plasticizers reduce viscosity or impart resilience at the expense of performance at elevated temperatures.

Inert fillers may be added to the epoxy resin system to achieve opacity and cheapness, to improve hardness, wear resistance, thermal conductivity, electrical and mechanical properties, to increase viscosity or to reduce the coefficient of expansion, or possibly the temperature rise during the exothermic reaction. Such fillers as silica, mica, chalk, metal and graphite powders and asbestos, glass and synthetic fibres are commonly employed. The epoxy resin systems may be dyed or pigmented, and pastes of colouring matter dispersed in liquid epoxy resin, are available.

Numerous Applications

With these many possibilities of producing compounds based on epoxy resins that possess properties to suit particular requirements, it is not surprising that there is hardly an industry in which they do not find some applications.



Electrical water treatment pipe units made by Aquastat Ltd., the interior surfaces of which are finished with an Araldite based coating

The epoxy resin-hardener systems cure without splitting off volatile matter, without shrinkage and without the application of pressure. When cured, they exhibit excellent adhesion to most materials, possess excellent electrical and mechanical properties, and they are stable and resistant to chemical and atmospheric attack.

Surface Coatings

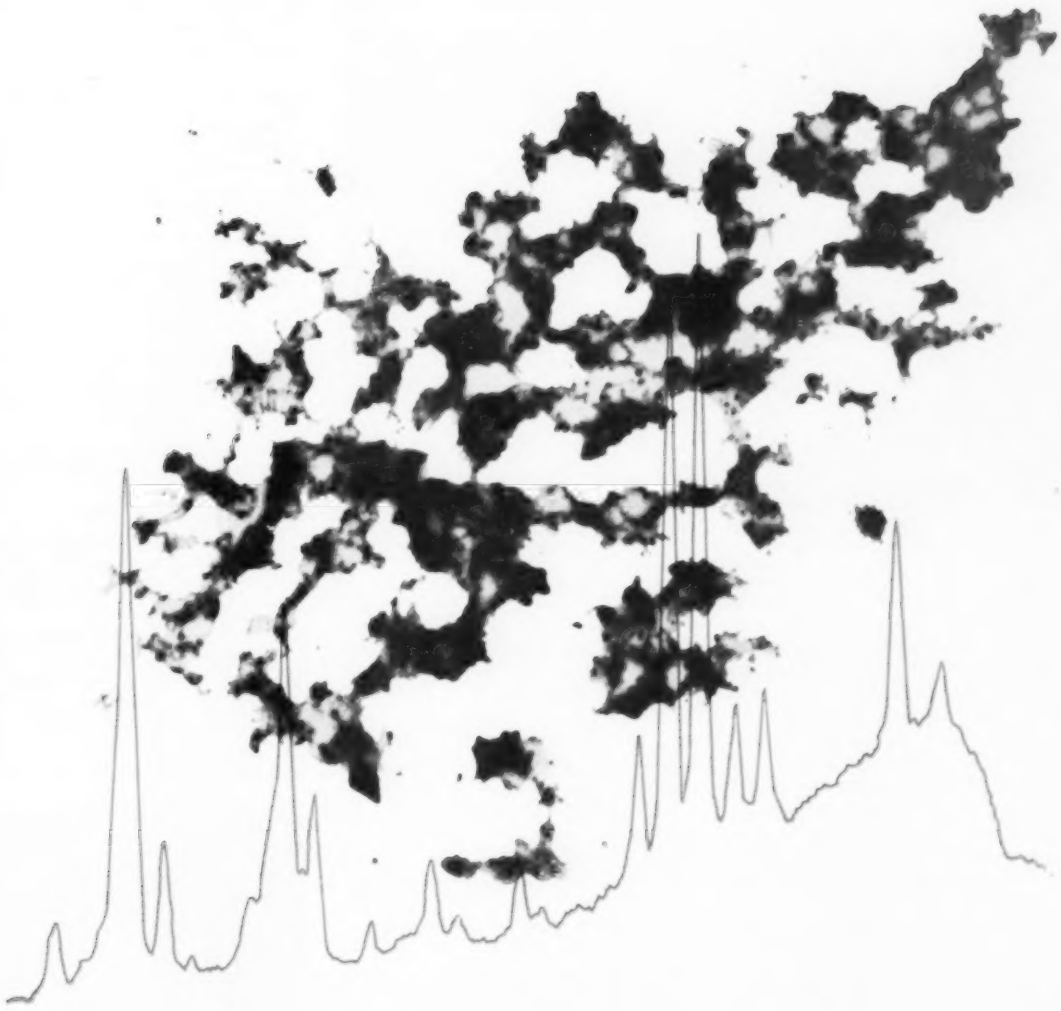
The surface coatings industry has taken particular advantage of the fact that epoxy resins are capable of reacting with a large number of other materials and that the resins have now become established in the paint industry in many systems ranging from air-drying anti-corrosive paints to high temperature stoving lacquers. Coatings based on these resins possess a combination of chemical resistance, adhesion, flexibility and hardness which has put them in a class by themselves.

Solvent-containing Types

The main types of solvent-containing finishes manufactured from epoxy resins, may be conveniently divided into four main classes: —

(1) Epoxy resins in solution may be blended with urea-, melamine-, or phenol-formaldehyde resins, to give clear or pigmented stoving finishes. Generally speaking, the higher molecular weight solid epoxy resins are employed in this type of formulation. They are used with phenolic resins to give coatings with maximum chemical and solvent resistance. Films are flexible, hard and tough, but dark in colour. Urea resins with epoxies give clear, colourless films which are less resistant than the phenolic-epoxy systems, but which nevertheless, possess a high degree of chemical resistance. Films based on melamine-epoxy systems, possess better gloss, colour and chemical resistance than the urea modified epoxies. Finishes based on the above combinations are stoved at high temperatures, usually in the range of 180°C. to 205°C.

The uses of phenolic modified epoxies include linings for food cans, washing machines, wire-enamels, coatings for chemical plant, and indeed, any application where hard, tough, flexible films with good adhesion are required, and where the colour of the film is of secondary importance. Metal may be coated with these finishes in the flat and formed later. Urea-epoxy systems are used as primers and finishes for



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Where does quality control begin? At the start of the production process? At the arrival of the raw material at the plant? LAPORTE quality control begins at the very origin: samples of titanium-bearing black ilmenite sand are flown from various continents to the Laporte Research Laboratories to prove their worth. How far does quality control extend? As far as the despatch of the product? LAPORTE quality control follows the product into the customers' works throughout its application.

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domestic and industrial equipment, chemical plant, can and drum linings, metal decorating finishes, and the melamine modified epoxies find similar uses.

Epoxy resin mastic being applied as a surface coating to the portal section of an off-shore production platform built by Eonit Engineering for the British Petroleum Co.

(2) Epoxy resins are utilized in the manufacture of two-can formulations where the resin is included in one component and the chemical hardener in the other. The lower molecular weight solid resins are normally utilized in this type of system. The hardeners include polyamines or adducts made by reacting the amine hardener with part of the epoxy resin. These adducts are subsequently used to harden the remainder of the epoxy resin. This technique reduces the hygroscopicity of the basic amine. Polyamide resins are also used to cure the epoxy resins, and generally speaking, give better flexibility and water resistance than the amine adducts, but tend to be slower in curing.

Cold Curing Products

The many applications for these two-can formulations, based on epoxy resins, depend on their property of giving outstanding chemical and physical properties, without the need for stoving. They include the coating of marine, road, rail, and storage tanks of metal or concrete to protect them from corrosion or to preserve the purity of the materials contained in the tanks. They are used as finishes for general chemical plant protection and for coating concrete. They also find use in aircraft because of their resistance to synthetic lubricants and hydraulic fluids. Other uses include wood and paper coatings and drum finishes.

(3) Epoxy resins may be reacted with fatty acids to give esters which may be used in air-drying or stoving formulations, depending on the nature of the fatty acid chosen. Generally, solid resins of medium molecular weight are chosen. Finishes based on air-drying esters are employed for the protection and maintenance of structures in corrosive atmospheres, primers and finishes for vehicles, aircraft finishes, floor varnishes, drum paints and printing ink. The finishes based on stoving epoxy esters may also include the addition urea- or melamine-formaldehyde resins. These coatings are used as primers and finishes for domestic appliances, can and drum coatings, automobile primers, wall board coatings and exterior collapsible tube coatings.

(4) Epoxy resins may be used in several other ways in the formulation of finishes; for example, they may be used to replace glycerine or a similar alcohol in alkyd formulations, to give both air-drying and stoving types with better adhesion and chemical resistance. Solutions of epoxy resin are sometimes added to combinations of urea- or melamine-formaldehyde resins with alkyds to give finishes which stove at around 150°C. with improved chemical resistance and adhesion.

Apart from the formulations mentioned above, epoxy resins are also used in combination with iso-cyanates, silicone resins and cold tar pitches and latest developments include the possibility of water based emulsion finishes.

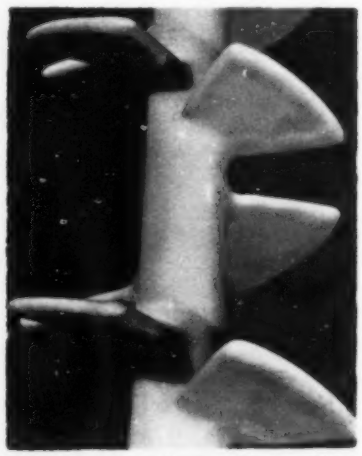
High Solids Coatings

As has been said, the epoxy resins generally employed in surface coatings are the solid grades, but by using liquid epoxy resins, it is possible to formulate two-can systems containing a very small proportion of solvent as thinner. Such systems have several important economic and practical advantages over conventional systems. For instance, the 'high solids' finish can act as its own filler and sealer. The film thickness of one coat is equal to that obtained with several coats of conventional paint, which results in a saving in time, and the labour and cost of application.

Epoxy based paints with solid contents of 85% or higher, are applied by brushing, spraying or roller coating, in industrial applications. They have been shown to possess a high degree of chemical, water and fume resistance. They have been used in atomic plants and laboratory installations where they withstand constant washing with hot caustic solutions to radio-active accumulations. Other uses include finishes for breweries and dairies, where resistance to daily washing and the fact that they do not support fungus growth, is important.

Solvent-free Finishes

Solvent-free epoxy finishes are the logical development of the high solids types. Here again, liquid resins are used and coatings of 0.005in. to 0.010in. or even 0.020in. are applied in one operation giving a protection 'in depth' without the labour costs involved in applying several coats. Indeed, one coat will produce a film thickness at least equivalent to that normally obtained with four or more



Epoxy based, solvent-free, coatings may be applied to complex shapes such as this

coats of a conventional painting system. Also important is the fact that the fire hazard is reduced by the absence of solvents. Epoxy resins succeed in this sphere because of their adhesion, chemical resistance and low shrinkage, and because of the many chemical possibilities of formulation.

Cold curing epoxy solvent-free finishes have many properties in

common with the solvent-containing 'two-can' coatings. Apart from excellent adhesion to most surfaces, they are hard, tough and resistant to chemical attack. Table 1 illustrates the chemical resistance of one typical solvent-free coating based on a special epoxy resin-hardener system.

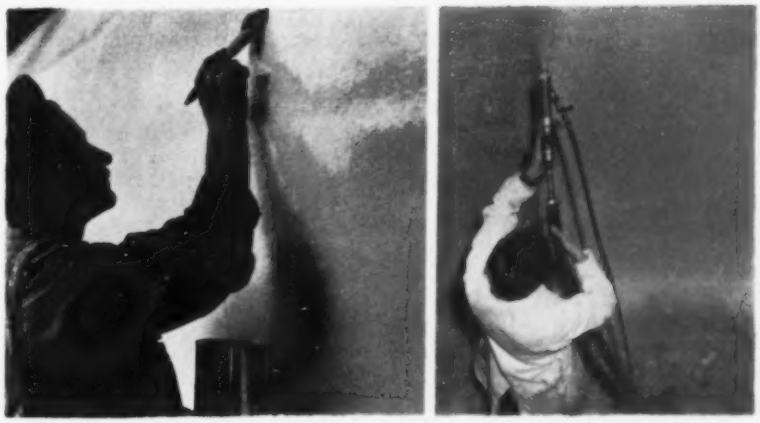
TABLE 1

The condition of films after 6 months' immersion in the test fluid at room temperature. Films of 0.010in. were applied to shot-blasted steel rods and cured for 7 days at room temperature

Water	—	Excellent
Sulphuric acid	3%	Excellent
" "	70%	Failed
Hydrochloric acid	10%	Excellent
" "	37%	Excellent
Nitric acid	30%	Failed
Phosphoric acid	4.25%	Excellent
" "	10%	Excellent
" "	43%	Poor
" "	64%	Poor
" "	85%	Poor
Acetic acid	10%	Excellent
" "	Glacial	Failed
Sodium hydroxide	1%	Excellent
" "	5%	Excellent
" "	20%	Excellent
" "	50%	Excellent
Ammonium hydroxide	10%	Excellent
(S.G. 0.88)	Conc.	Good
Sodium chloride	20%	Excellent
" sulphate	30%	Excellent
Acetone	—	Failed
Diacetone alcohol	—	Failed
Iso-propyl alcohol	—	Excellent
Sec. butyl alcohol	—	Good
Ethyl acetate	—	Failed
Trichlorethylene	—	Failed
Petrol	—	Excellent
Crude oil	—	Excellent
Kerosene	—	Excellent

Coatings based on solvent-free epoxy resin systems are already finding use for the protection of equipment and fittings for industrial and marine plant. The development work already carried out with one resin-hardener system alone included the following applications which give a brief indication of the very large potential market of this type of product.

Coating concrete tanks to hold paper pulp (pH 5.0-5.5) at a temperature of 70°C. (158°F.). Coating the rudders of a number of ships. Coating metal ducting exposed to 4% sulphuric acid at temperatures up to 60°C. (140°F.). Coatings applied to concrete and various metal fittings in sewers. Coating metal storage tanks to hold sugar derivatives. Coating metal storage tanks to contain beer and cider. Repair coatings to glass-lined vessels for latex. Coating ships' tanks for carrying crude oil and ballast sea-water. Coating farm equipment, *e.g.* fertilizer spreaders and other equipment for containing corrosive materials. Coating condenser end boxes in which sea-water is used as a coolant. Coating oil drilling towers for marine use in the Persian Gulf.



An Araldite-based system being brush applied to the walls of a factory boiler, used with calico laggers to protect the thermal insulation. Solvent-free coatings may also be sprayed—as shown here on the internal walls of an aluminium storage tank for formalin

Flooring

The development of solventless epoxy systems has led to the establishment of these products in the manufacture of flooring compounds. Here, suitable resin-hardener mixtures are extended with a suitable filler such as sand. The choice of the sand is particularly important to give the required properties. The cold curing systems adhere strongly and permanently to new or existing concrete, and indeed, many other surfaces. Generally speaking, the compound is laid to a depth of ¼in. and the weight is around 25-30lb./sq. yd. The compounds can be readily laid around existing plant and structures, thus eliminating the removal of plant, and reducing production stoppages to a minimum. The flooring hardens by chemical action, and may be walked upon 24 hours after laying and it will withstand the effects of light vehicular traffic after 48 hours. Longer periods are advised before the flooring is exposed to heavy traffic, and indeed, maximum chemical resistance and strength may require seven days to develop.

The epoxy resin flooring has many outstanding advantages, for example, it is very resistant to chemicals, is non-slip, it withstands heavy traffic, it possesses high impact strength and lightness, and there is no dust hazard. The epoxy flooring compounds are many times stronger than concrete and for example, the tensile strength is of the order of 1,000 psi, the compressive strength greater than 10,000 psi and the flexural strength over

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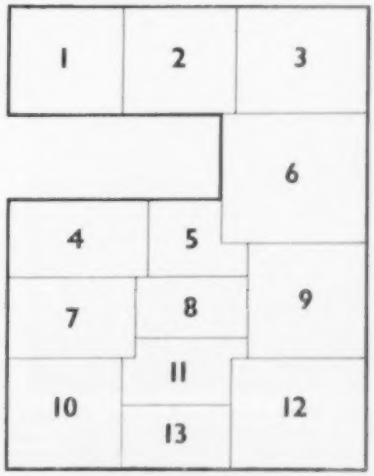
Key to Applications on page 461

1. The roof of this cathedral in Puerto Rico is coated with Hypalon to provide lasting weather protection. 2. Joint in pvc cable using Bakelite epoxide resin. 3. Chemical and abrasion resistance of neoprene protects the vat and agitator used for metal processing. 4. Proofed nylon fabric tanks for liquid storage. 5. Aerodux 185 resorcinol adhesive is used in these laminated portal arches intended for use in a corrosive atmosphere. 6. A neoprene lining protects the entire interior of this Dorr Oliver thickener against chemical slurries. 7. Sink waste trap made from British Resin Products HD polythene. 8. Pipework coated in automatic equipment by Plastics Coatings Ltd. 9. BTR pvc pipes and fittings used for conveying hydrochloric acid and other chemicals. 10. The drawing of glass fibres, starting point for numerous corrosion resistant structures. 11. BX Plastics Cobex rigid pvc fan and housing. 12. Clothing and respirator, proof against corrosive vapours at high temperatures. 13. This propeller shaft is protected with a glass epoxy wound-on coating

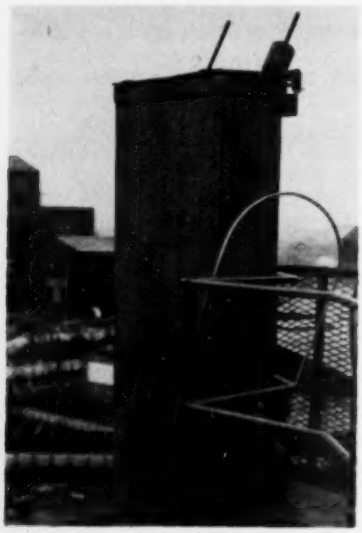


2,500 psi. Virtually no stresses are set up in the flooring, since negligible shrinkage takes place in the resin system during curing. It will be appreciated that lines of stress would normally be more readily attacked by chemicals. Chemical resistance tests have been carried out in the laboratory by continually immersing cured epoxy based flooring compounds in a wide range of chemicals for very long periods of time. The results obtained are indicated in Table 2.

TABLE 2
CONTINUED IMMERSION OF FLOORING COMPOUND

Sulphuric acid up to 70%	Satisfactory
Hydrochloric acid up to concentrated	Satisfactory
Nitric acid up to 30%	Satisfactory
Phosphoric acid up to 85%	Satisfactory
Sodium hydroxide up to 50%	Satisfactory
Ammonium hydroxide up to concentrated	Satisfactory
Sodium chloride solutions	Satisfactory
Sodium sulphate solutions	Satisfactory
Diacetone alcohol	Satisfactory
Petrol	Satisfactory
'Redex'	Satisfactory
Motor oil	Satisfactory
Acetic acid	Unsatisfactory
Formic acid	Unsatisfactory
Acetone	Unsatisfactory
Trichlorethylene	Unsatisfactory

It will be appreciated that in actual use chemicals spilled onto a floor tend to be washed away by the copious application of water and continuous immersion tests are rather severe. Nevertheless, the results indicated above have been borne out by practical experience. For example, an epoxy-based floor has been in almost continuous use for about three years in a tannery where it has been exposed to chemical solutions containing sulphuric acid, borax, salt and enzymes.



This glass-reinforced epoxy ducting, at a sulphuric-acid plant, carries sulphur dioxide at a temperature of 60°C.

Epoxy-based floorings are already performing successfully in chemical plants, tanneries, sweet and biscuit factories, breweries, laboratories, drum washing plants, plating shops, food factories and paint spray shops.

Protection of Thermal Insulation

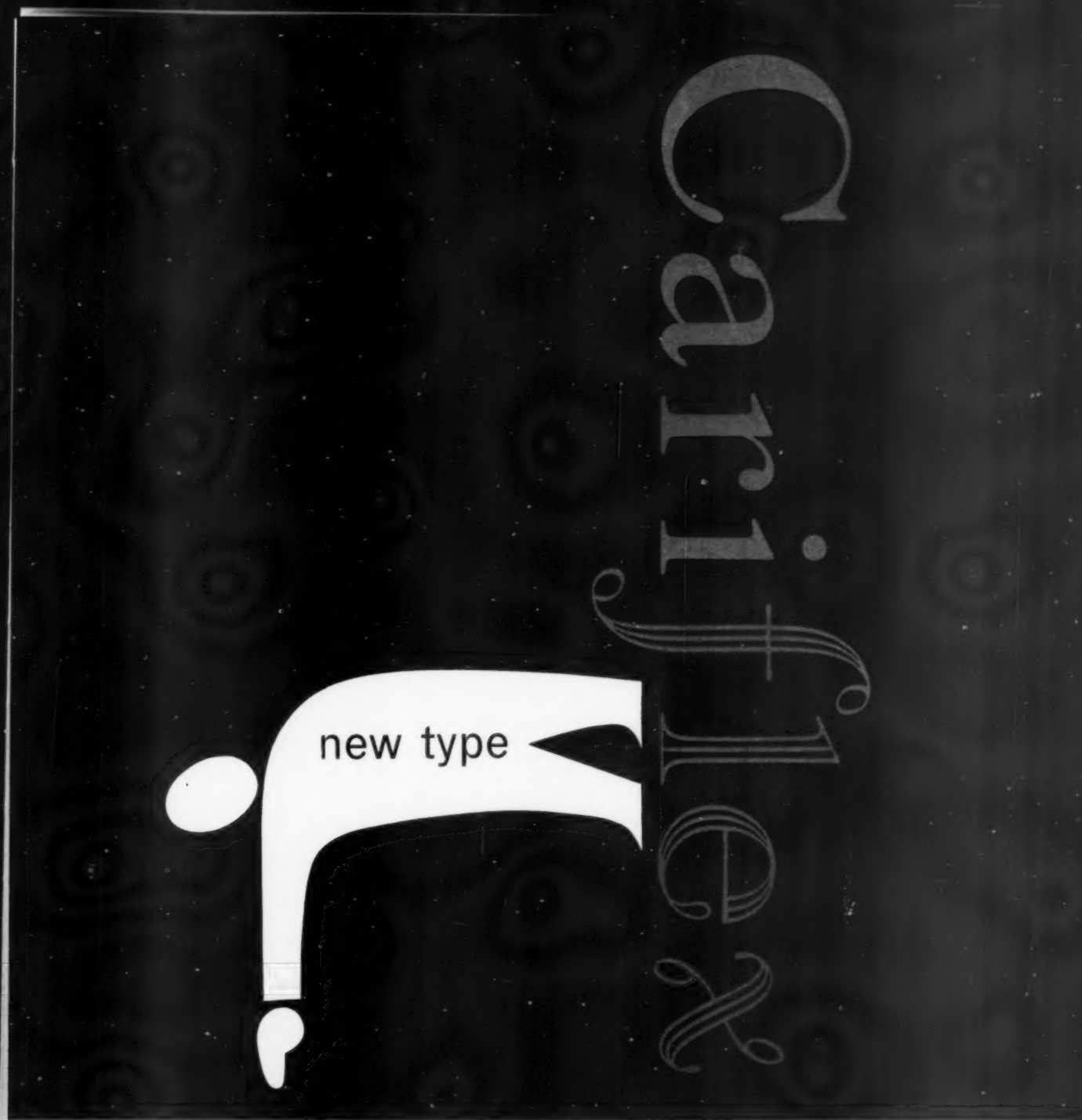
In a great number of industries, industrial plant is finished with some form of insulation material which is not usually particularly strong, or resistant to moisture or chemicals. In many instances, this is protected with paint, roofing felt and chicken wire, or metal sheeting. For example, large water tube boilers, after application of the various insulation materials, are finished on the outside with a light gauge metal casing which is an expensive item. In one case, the boiler walls were finished with asbestos cement and it was decided to use a pvc fabric as the casing. This was capable of withstanding the temperature of the boiler walls, and was flexible enough to cope with the boiler expansion. Tests were carried out with a number of adhesives and an epoxy resin was chosen because it met all the requirements. It made the best bond between the asbestos cement and the pvc fabric without any sign of ageing. This technique has proved to be entirely satisfactory in operation and the cost of finishing the type of boiler involved was well below the cost of metal cladding. A similar technique has been applied to factory boilers, although calico cloth was used in place of pvc and the epoxy resin used as a laminating resin, rather than as an adhesive. Chemical reaction vessels have also been finished in the same way, using either calico, glass or synthetic fibres as the reinforcement, with the epoxy resin as a laminating material. This finish has been found superior to metal sheet for protecting the insulation on chemical reaction vessels, since when the metal is bent or damaged by impact, chemicals tend to penetrate and attack the lagging, degrading it so that it has to be replaced every few months.

Epoxy resin with fibrous reinforcement has been used to protect the insulation of chemical reaction vessels subject to the impact of barrels and it has been found that the finish is capable of being washed down and cleaned; so far, has had a life of well over 18 months and is still in good condition. It will be appreciated that this system of armouring lagging with an epoxy resin is of particular value in chemical plant, where such a finish withstands not only chemical attack but also the impact of ladders and other possible damage during fitting operations.

A porous carbon candle filter constructed by Resinform Ltd. used for clarifying acid liquors and capable of withstanding pressures of 50psi

Fibrous Reinforced Epoxies

Much has been written in recent years about glass fibre reinforced plastics, and most published articles have been devoted to polyester laminates. Epoxy resins are comparatively new in this field, and are more expensive than polyesters. For high performance applications, however, epoxy resins offer several important advantages over alternative materials. They adhere strongly to glass and have a small shrinkage. In consequence, epoxy laminates show a high degree of interlamina adhesion, and higher compression and flexural



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strengths than are obtained with conventional polyesters. Moduli of elasticity are also higher, wet strength retention, particularly under load, and chemical resistance are outstanding. The low shrinkage results in laminates with little internal stress, freedom from warping and dimensional stability. The surface qualities are excellent with absence of cracking or crazing. The electrical properties are good.

Other data indicate superiority of epoxy glass laminates when exposed under fatigue conditions. The adhesive qualities of epoxies enable composite assemblies to be made incorporating metal or other components in the laminate structure during manufacture. Both the wet lay-up and dry lay-up techniques may be employed.

In the wet lay-up technique, liquid resin mixtures without solvents are used to impregnate the cloth. In the dry lay-up technique, the glasscloth is impregnated with a solvent-based mixture of resin and hardener, the solvent dried off and the dried cloth stacked and cured under pressure.

Chemical Piping

The outstanding properties of epoxy resins have led to their use in the production of glass-reinforced piping. Such piping has high chemical resistance, even at fairly elevated temperatures and under pressure, together with dimensional stability, and it is mechanically strong although relatively light in weight. Fittings, flanges and junctions can also be made easily. Laminating with glass fibre is also a most appropriate method for making tanks, hoppers, ducting and other items of chemical plant.

Epoxy-glass protection is applied to the propeller shafts of vessels in the Royal Navy. This technique was chosen after many other methods had been proved unsatisfactory. The laminate provides protection against corrosion, is strong yet resilient enough to withstand the effects of vibration, while the adhesion of the resin to the steel is obviously of importance. Epoxy resins, in conjunction with glass fibre, are used for armouring and lining pipes and vessels made of low-strength materials such as stone, glass, pvc, and polythene.

Epoxy Casting Resins

Casting of epoxy resins is normally carried out by simple gravity techniques. The epoxy resin-hardener mixture in a liquid state, is poured into moulds of metal or plastic or other suitable material, and cured. Although the term 'casting' is used to describe the general process, it usually implies the production of a component where the mechanical, as well as the electrical insulation properties, are prominent. Potting, or encapsulation implies the complete embedment of an electrical component in a protective mass of resin, which not only insulates, but also protects the article against vibration, shock, chemical attack, and prevents ingress of dust and moisture.

Cast epoxy resin valves, taps and pipes are used in chemical works and, when filled with graphite or molybdenum disulphide, as bearings. Accuracy of the castings, dimensional stability and chemical resistance, are among the main reasons for the success of the resins in this field.

In the electrical industry the relatively expensive epoxy resins compete successfully with the many long established forms of insulation. Their dielectric properties are excellent, particularly in the power and audio frequency ranges. Dielectric loss is less than that for porcelain, phenolics and pvc, while volume and surface resistivity are higher. Mechanical properties are good, and tensile and impact strengths are better than porcelain, for example. Adhesion to most materials, negligible shrinkage, non-evolution of volatiles, good moisture and chemical resistance, are also advantageous. It is also possible to choose a resin system or a method of use, to suit an application. Mixing and casting can be carried out under vacuum, so that resulting insulation may be free from voids, which is particularly important where steep potential gradients will be encountered, as in most high voltage work.

Switchgear

It is in the field of power engineering and particularly in the manufacture of switchgear, that epoxy resins have reached great commercial significance. Insulators and bushings made from epoxy resins are replacing the conventional porcelain and SRBP types. Those in epoxy resins are stronger than porcelain, and metal fittings can be 'cast in' eliminating further expensive cementing operations, and they are superior to SRBP in tracking and water resistance.

Epoxy resins can be cast into large, complicated and accurate shapes, and new designs can be evolved in which many composite parts are cast together and unorthodox conductor arrangements used where clearances are kept to an absolute minimum. Both bar and wound forms of current transformers are cast in epoxy resin, and single and three-phase types are in production. Advantages include, improved tracking and water resistance, higher impulse strength and less liability to ionization. Good short circuit strength can be obtained, and, should failure occur, fire does not result. Voltage transformers, slip rings, commutators, rotors, and many other components are successfully potted in epoxy resins. In the electronic industry components such as resistors, condensers, transformers, coils, rectifiers and transistors, etc., are also encapsulated.

In some cases, however, components are protected with a thixotropic, solvent-free epoxy resin system applied by dipping. Epoxy moulding powders have been developed and possess high insulation strength, good heat resistance, little tendency to crack, even with large metal inserts, and excellent stability on exposure to heat and high humidity. Epoxy dough moulding compounds are also being developed.

Miscellaneous Applications

The applications of epoxy resins so far described cover the main uses where their resistance to attack in corrosive atmospheres is important. They are also widely used as adhesives and, here again, their resistance to most environmental conditions is valuable. Epoxy resins are also used in the manufacture of tools including checking fixtures and duplicate models, press tools, drop hammers, hammer forms, router and drill jigs, vacuum forming tools, foundry patterns, and for the manufacture of tools for the production of reinforced plastic laminates. There are many other applications of these versatile epoxy resins such as in the production of fillers, chemical stabilizers *(e.g.* for pvc) and for mounting bristles into the handles of brushes.

Although epoxy resins are used in many applications, since they not only possess a unique combination of properties, but they are available in many forms and can be used in a variety of ways, they are particularly valuable in applications where it is required to withstand corrosive conditions. As a group, they possess outstanding stability and excellent resistance to atmospheric and chemical attack.

Epoxies for Cable Joints

Shell Chemical Co. Ltd. has developed special compositions, based on 'Epikote' epoxy resins, for sealing electric cable joints. These compositions are said to cure quickly at ambient temperature to form a watertight seal around the joint.

They are claimed to be particularly suitable for use with pvc insulated cables.

CORROSION and INSULATION

Rubber Plant Linings

MANUFACTURER SHOULD BE CALLED IN AT PLANT DESIGN STAGE

By S. McCARTHY, Dunlop Rubber Co. Ltd., General Rubber Goods Division

ALTHOUGH there are earlier references to the use of rubber as a protection against corrosion and abrasion, the more general use of rubber linings may be said to have originated during the First World War. At that time a railway transport tank was lined with ebonite, and immediately after the war a number of similar tanks were lined. In America, soft rubber linings were preferred and in 1921 a specification was issued controlling the design of tanks to be rubber lined.

Since then the improvements in compounding ingredients and techniques have led to continuing improvement in rubber linings. The more recent discoveries of synthetics have not detracted from the value of natural rubber. On the contrary, they have extended the range of the rubber linings manufacture by providing protection in environments where natural rubber could not be used. The continuing development of new elastomeric materials provides the manufacturer with an ever increasing range of materials, therefore reducing the number of applications for which elastomeric linings are unsuitable.

Diagnosis of Conditions

A suitable compound is, however, only one requirement for successful tank lining. Another and equally important requirement is full knowledge of the conditions which will be imposed upon the lining. Not uncommonly the most difficult problem faced by the rubber manufacturer is the diagnosis of the actual conditions likely to be encountered in service. Even when full information is given, it may be a matter requiring detailed investigation and experimental work in order to determine the most suitable lining material. It is surprising how often enquiries are received regarding linings for expensive plant, accompanied by vague statements such as: 'the plant is required for handling acids or perhaps sulphuric acid of 20%'.

Allied to this problem is the question of plant design. Points of design which have little effect on the construction or performance of the plant can be very significant to the rubber manufacturer. Raised rivets, internal reinforcements, inaccessible components — these all create unnecessary problems. Unnecessary in that, if the rubber manufacturer had been called in at the drawing board stage, he could have pointed out the snags which would occur and a more satisfactory and possibly a more economical lining job could have been performed.

Rubber lining manufacturers possess an extensive fund of experience which is available to all actual or potential users. There is no official 'guide book'. It is therefore in the interest of both parties that the question of rubber and allied linings be discussed fully and frankly during the plant design stage.

Two Lines of Approach

Having obtained the essential facts the lining manufacturer can determine the type and method of lining. With regard to the method there are two principal lines of approach. The plant may be lined at a specialized rubber lining factory or it may be lined *in situ*. Frequently, the size of the plant determines the method, but other considerations — such as material of construction, location, the requirements of other contractors — must be taken into account.

Fig. 1. Shot-blasting immediately before applying the first coating

Generally speaking, it is preferable for the lining work to be carried out in a rubber lining factory where controlled conditions and heat vulcanization under pressure can be applied to give the best results. The largest vulcanizers in this country are up to 15ft. in diameter and 25ft. long and even this large size imposes limits on the size of plant which can be accommodated.

Vessel its Own Autoclave

An alternative method of curing, which can be adopted in specific circumstances, is to use the lined vessel as its own autoclave. This method can be applied to vessels which are, or can be, completely enclosed provided that facilities are available for steam injection and the drainage of condensate. Vulcanization is effected by blowing live steam into the vessel at amospheric or at moderate pressures. In the latter case, the vessel must be tested to twice the curing pressure before lining and it is normal practice to shroud the exterior in order to reduce heat loss.

It is also possible to build plant in sections which can be vulcanized individually and subsequently assembled on site.

Where factory lining is not possible, then site lining must be adopted and vulcanization may be effected by any one of several methods, *e.g.* open steam, boiling water, hot air, chemical treatment or surface accelerators at ambient temperatures. In each case the compound must be designed not only to meet the corrosion requirements but also to satisfy the particular curing technique.

The above comments refer particularly to the use of sheet material. This is the most popular and successful system of lining, although other methods have been developed which are particularly suitable for specific applications. The principal methods of applying rubber coverings are:

1. Sheet Application—Factory Lining

A wide range of materials is available for application in sheet form. The basic material properties can be modified or enhanced to provide

widely differing chemical and abrasion resistant characteristics.

The sheet material is produced either by extrusion or calendering. In the latter case it is normal practice to build up the calendered sheet from thin plies to avoid blisters, pinholing and other blemishes. From this material are cut separate panels, generally of the largest possible size which can be handled, in order to reduce the number of joints to a minimum. To ensure that the joints are relatively flat and of maximum contact area, the edges of the panels are cut with long chamfers or bevels.

The vessel to be lined is thoroughly cleaned by wire brushing, shot blasting or other methods (Fig. 1). This is immediately followed by the first coat of the selected adhesive system which also ensures that the surface to be lined is temporarily protected against contamination or oxidation. Several coats of solution or adhesive are generally required and when they have been applied the lining panels are placed in position (Fig. 2). They are pressed into intimate contact with the solutioned surface by rollers or heated hand tools.

Testing for Breaks

After application, the lining is tested by means of a high voltage discharge probe, which effectively pinpoints any break in the rubber covering (Fig. 3). At this stage any faults can be rectified quickly and without detracting from the efficiency of the lining.

Fig. 2. Application of rubber lining panels to a cleaned, solutioned vessel

The lined vessel or plant is then partially vulcanized or shrunk cured to relieve all stresses, after which it is again electrically tested. Again, at this stage effective repairs can be carried out.

Typical shrink cures are: 20min. at 286°F. (40lb. psi) steam; or 30min. at 300°F. hot air; or 120min. at 212°F. steam at atmospheric pressure.

Following the shrink cure and inspection, the lined vessel is subjected to a further curing cycle in order to complete vulcanization (Fig. 4). Typical curing times are, for soft rubbers: 1½hr. at 286°F. (40lb. psi) steam; or 1hr. at 300°F. hot air; or 12hr. at 212°F. steam at atmospheric pressure.

For hard rubbers or ebonites: 3hr. at 286°F. (40lb. psi) steam; or 3hr. at 300°F. hot air; or 24hr. at 212°F. steam at atmospheric pressure.

Following the full cure, a final electric spark test is applied. At this stage the rubber lining should be completely free from pin-holes or any other break in continuity. Repairs, other than of a very minor nature, should be unnecessary and should only be carried out with the consent of the user.

2. Sheet Application: Lining in-situ

In principle, the method outlined above can also be applied to the lining and covering of plant 'on site' (Fig. 5). The methods of vulcanization will vary according to the material of construction, lining material, available services, location, and urgency. Available methods of curing on site include the following:

(a) Steam blown into the vessel at atmospheric pressure.
(b) Steam at higher pressures — for suitable pressure tested vessels.
(c) Hot air — for suitable, accelerated lining compounds.
(d) Surface accelerators at ambient temperatures or followed by hot air.
(e) Application of sulphur carriers to accelerated lining compound, *e.g.* carbon bisulphide applied to compound containing di-benzylamine.
(f) Prolonged exposure of lining compound to atmospheric temperatures. The period of exposure may be from three to eight weeks.

Fig. 3. Spark testing an unvulcanized lining using a 25,000-V., low-amperage test set

Using the above methods, sheet linings can be successfully bonded to plant constructed of metal, concrete or wood. The question of bonding, although generally of considerable importance, does not always arise. In some specialized applications where only a liquid tight membrane is required, a loose vulcanized lining may suffice. The lining may be prefabricated or may be tailored to the vessel *in situ* (Fig. 6).

3. Brushed or Sprayed Coatings

Certain elastomers, notably chlorinated natural rubber, neoprene and Hypalon are available in paint form. They can be applied by normal painting techniques and are becoming increasingly popular.

Originally, rubber 'paints' were used mainly for the protection of structural steel work, outer surfaces of lined vessels and similar items. They are still used for such applications and with very satisfactory results. There is, however, a trend towards the use of painted coatings for primary rather than secondary protection.

Neoprene, and to a lesser degree Hypalon, are being used as films of up to $\frac{1}{16}$in. thick for such heavier duty. An average sprayed coat of neoprene will be between .001in. and .0015in. thick. Brushed coatings tend to be somewhat thicker. For the protection of uncomplicated vessels it is therefore debatable whether there is any economic advantage in applying several brushed coatings rather than a single sheet. Technically, the sheet should give superior protection.

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Nevertheless, there are many instances where sprayed or brushed coatings can be usefully employed — *e.g.* in locations of limited accessibility or where the item is of a very complex design.

The success of painted coatings depends entirely upon the standard of workmanship and the care taken during preparation. Adhesion between successive coats can only be assured by cleanliness and an even coating, particularly on vertical surfaces, can only be attained by careful brushing out. For multi-coat applications it is good practice to use contrasting colours for alternate coats. This provides a reasonable means of ensuring that complete coverage is obtained with each coat.

Vulcanizing agents are generally included in paint formulations and accelerators may be added prior to use. The paint dries and toughens within a few hours but complete vulcanization usually takes two to three weeks at normal atmospheric temperatures.

The finished product is tough and provides good protection against corrosion, abrasion and mechanical damage.

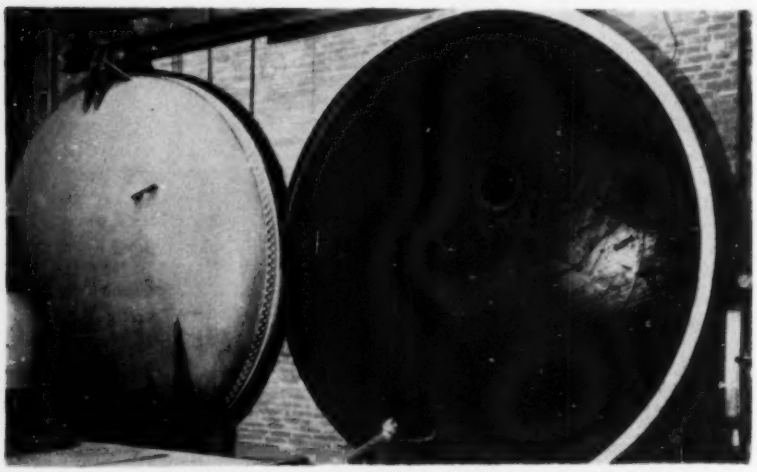

Fig. 4. Autoclave vulcanizing. This autoclave is one of the largest in Europe

4. Dipped Coatings

This method is little used but it is of value for the application of rubber coatings to wire screens. The article to be coated is first cleaned and then dipped into either compounded latex or a specially compounded rubber solution. Dipping is repeated until the required thickness is obtained after which the product is dried and vulcanized.

Despite the specialized utility and simplicity of dipped coatings, there are serious limitations: —

(a) Adhesion to the metal is not of a high order.
(b) The physical properties of the coating are limited.
(c) The thickness of the coating cannot be accurately controlled and is liable to variation.

5. Electrodeposition

As an alternative to dipping and when hand covering would be too expensive, this process is used to a limited degree for covering intricate screens and so on.

The object to be coated is used as an anode and placed in a tank containing latex which has been compounded so as to possess electrolytic properties. When an electric current is passed through the tank, latex is deposited on the anode.

Again this process is not widely used due to the following limitations:

(a) The choice of compounding materials is limited by electrical properties, density and particle size.
(b) Adhesion to metal is usually poor.
(c) Equipment costs are high.

Having briefly discussed the principal methods of applying elastomeric coatings, the principal materials used by the lining manufacturer for the protection of chemical plant can be considered.

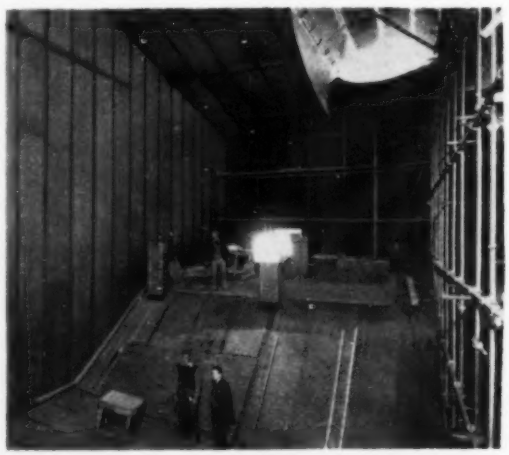

Fig. 5. Lining on site: part of the rubber-lined interior of an absorber at the Anglesey works of the Associated Ethyl Co. Ltd.

A. Natural Rubber

Still the most widely used of all elastomers, natural rubber compounds of varying properties and in a wide range of hardness are used in many types of chemical plant.

NR compounds are resistant to most inorganic chemicals and to most acids and alkalis excluding the higher oxidizing acids such as chromic and nitric. They are not recommended for contact with aromatics or aliphatic hydrocarbons or for mineral oils.

Subject to the careful selection of compounding ingredients the chemical resistance of natural rubber compounds increases as the hardness increases. Abrasion resistance increases as the hardness is reduced.

Of all the natural rubber compounds, ebonite provides the greatest overall chemical resistance. It is, however, more susceptible to mechanical damage than soft rubbers and should not be applied to plant which is liable to excessive flexing or vibration. The normal maximum operating temperature for ebonite is 70°C. Beyond this temperature, thermoplastic softening takes place. Most lining manufacturers are, however, able to produce special grades of ebonite to withstand higher temperatures. Some grades will withstand continuous operating temperatures up to 110°C.

B. Neoprene

Although similar in general properties to natural rubber, neoprene possesses greatly improved resistance to dry heat, ozone and sunlight. It swells slightly in contact with mineral and vegetable oils but the physical

properties are only slightly affected.

Neoprene linings provide good protection against oxidizing reagents, organic compounds, inorganic chemicals, alcohols and many aliphatic hydrocarbons. They should not be used in contact with halogenated hydrocarbons or aromatics.

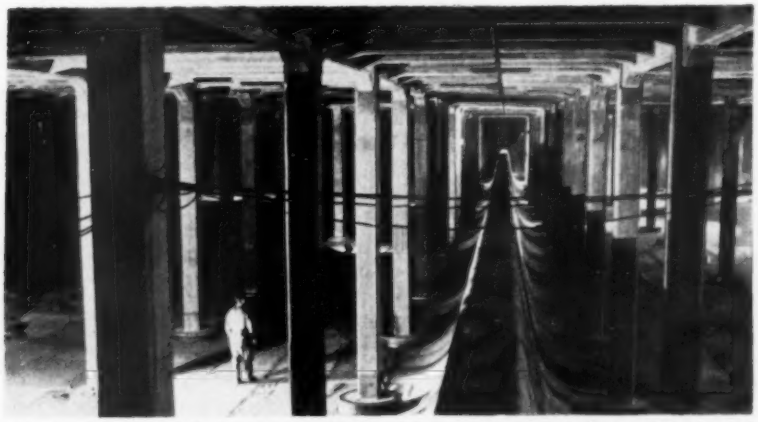

Fig. 6. Unbonded linings: vulcanized rubber membrane being applied to the interior of a reservoir to prevent water loss due to cracking of the concrete structure *Photo: Sunderland and South Shields Water Co.*

C. Butyl

In general, butyl compounds exhibit lower water absorption, greater heat and ozone resistance than corresponding natural rubber compounds. Butyl compounds also resist permeation by gases to a very marked degree. This characteristic is of value in many applications but it calls for considerable care in the preparation and application of butyl linings.

In most applications, butyl is superior to soft natural rubber compounds and a very useful feature is that whereas natural rubber deteriorates at elevated temperatures (100°-120°C.) butyl actually improves in resilience.

D. Nitrile Rubbers

All the nitrile rubbers possess exceptionally good resistance to oils, heat and light ageing. They also exhibit good low temperature flexibility.

Nitriles are suitable for contact with aliphatic hydrocarbons, ethers and alcohols, many inorganic salts and vegetable oils. They can also accommodate stronger concentrations of oxidizing acids. They are not suitable for exposure to phenols, esters, ketones, nitrogen, derivatives, acetic acid, aromatic solvents or halogenated hydrocarbons.

E. Polysulphides (Thiokol)

This elastomer is unique in its resistance to many of the solvents which cause swelling or degradation in natural and most synthetic rubbers. It also has good resistance to ozone and sunlight.

The mechanical properties of polysulphide are, however, rather poor and this together with the characteristic, objectionable odour has tended to restrict its wider application.

F. Hypalon

Increasing interest is being shown in this elastomer for protection against the higher oxidizing acids, high temperatures and, in particular, sunlight and ozone. It is already in popular use as a protective paint and its use as a lining material has extended the use of rubber-like linings for higher temperature applications in the plating and allied industries.

G. Viton

One of the more recent additions to the rubber-like lining materials, Vitons possess heat and chemical resistance properties far in advance of other elastomers. Partly because of these very properties it is a difficult material for hand building and fabrication processes.

It is an expensive material but there is no doubt that when suitable processing techniques have been developed, the high cost will be justified by the high degree of protection which will be obtained.

This list of materials is far from complete: it makes no mention of such materials as polyurethane and rubber/plastics laminates which are in use or under development to increase the industry's contribution in the fight against corrosion.

Little mention has been made of the allied problem of abrasion against which rubber so often provides protection.

No excuse is necessary for these omissions; no treatment of the subject could ever be complete — new problems in corrosion arise day by day and inevitably the industry will strive to provide new and improved protective materials.

Plastics Pioneer Against Corrosion

EXTRUDEX LTD. has been a pioneer plastics firm in the development and application of products to stop corrosion. It was the first firm to extrude large diameter pvc tube as rigid pipeline, and the first UK producer of plastic fume ducting and fans. Recently the firm announced an important new development in the fight against corrosion called 'Isokote', its registered trade name for bonded surface coatings.

Based on isophthalic polyesters and specially woven fabric reinforcements of glass, Terylene or other suitable fibres, these coatings are applied in successive layers by spraying and other methods, until the required thickness is built up. Among the many applications is the patching of leaking tanks, also linings for corroded or new vessels which arrest and prevent chemical attack.

A special advantage of the application of Isokote is that it can be applied *in situ;* therefore downtime is greatly reduced and dismantling and removal costs eliminated.

All types of tanks and hoppers carrying water, sand, coal and effluent have been lined with Isokote. The roof, valleys and gutters of a London film theatre have been completely coated for protection against the highly corrosive atmosphere.

Building up an Isokote bonded surface coating

CORROSION and INSULATION

Preventing Chemical Attack

THERMOPLASTIC STRUCTURES FOR LABORATORY AND PLANT

By H. P. ZADE, Rediweld Ltd.

AT this year's Corrosion Exhibition nearly 75% of the firms displayed polymers in one shape or form, and increased interest was shown in thermoplastics, particularly in the field of chemical plant.

Many attempts have been made to combat corrosion, and the application of cathodic protection of pipelines, for instance, has resulted in a substantial reduction of corrosion; but it is, of course, preferable to use materials for the construction of chemical plant which, inherently, are not susceptible to corrosion.

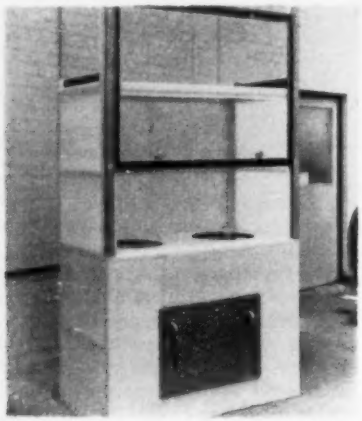

Fig. 1. Etching cabinet in polythene

While it is true to say that some of the non-ferrous materials and a few ferrous alloys are less prone to attack by acids and alkalis, they usually have only a limited application. A material which resists one acid may be entirely useless with another.

Although it would be an exaggeration to claim that thermoplastics materials can solve this problem in its entirety, there are considerable advantages in the use of some of them; for instance, polythene and rigid pvc. This article, by describing some of the applications, attempts to show the range covered by thermoplastics.

Etching cabinets are now being constructed using polythene (Fig. 1). This type of cabinet is intended for spraying television tubes with dilute hydrofluoric acid and complete resistance to this very corrosive medium is essential. A steel frame provides the mechanical support but all steel parts are completely enclosed in polythene, while the framework for the sliding window, including the slides, is made from rigid pvc, using an acrylic sheet to provide the transparent surface.

Sinks and receivers in a chemical laboratory take a good deal of punishment. A sink and receiver complete with siphon fitted in a laboratory bench is being made from polythene sheet by welding. The installation is used for the disposal of all kinds of inorganic acids, including hydrofluoric and nitric acid, with complete absence of staining or corrosion.

In the field of laboratory installations rigid pvc is being used in the manufacture of large scale fume cupboards for industrial installations. The whole of the superstructure is made in rigid pvc, built up on a timber base, while the top surface of the base itself is lined with pvc sheeting which also extends in to the individual sinks. A water circulating plant is incorporated in the fume cupboard, and washing of the fumes exhausted from the top of the cabinet is carried out by means of a polythene fume washer attached to the right-hand side of the fume cupboard.

The transfer of concentrated acids from carboys can be a dangerous operation. A hand-operated diaphragm pump takes the danger away, and such pumps are being made from moulded pvc sheet sections with a polythene diaphragm and will, therefore, stand up indefinitely to the

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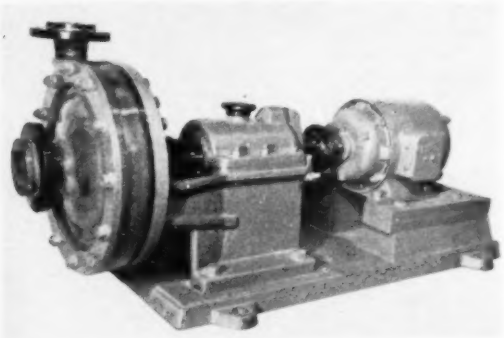

Fig. 2. Motor driven rigid pvc centrifugal pump used for acids and alkalis

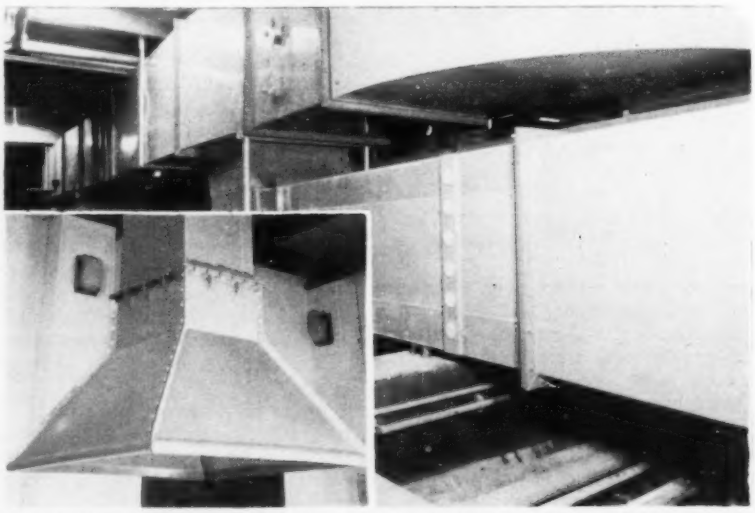

Fig. 3. Rectangular pvc fume ducting at the National Physical Laboratory, Teddington. Inset: this type of pvc fume hood is attached to the system

Unique idea becomes successful product with PLIOLITE LATEX

Unique in concept and construction is the best way to describe the handsome floor covering pictured above. The idea is to use it first as temporary carpeting, later as permanent padding under conventional carpeting. It's made of colourful, durable open-weave cotton, permanently bonded to long-lasting foam rubber. The price—surprisingly low!

A vital part in turning this bright idea into a successful product was played by PLIOLITE LATEX 5352. This new styrene/butadiene rubber latex was chosen primarily because it can be used *without* blending with natural rubber latex to make resilient, durable foam. Other reasons for its selection: Outstanding uniformity. Excellent physical properties.

How can Pliolite Latex 5352 help you put your product out in front? You'll find it makes an excellent, economical cushioning for *many* products. For details see your Goodyear Chemical Distributor.

Pliolite — T.M. The Goodyear Tire & Rubber Company, Akron, Ohio, U.S.A.

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CORROSION and INSULATION

Expanded Rubber

MOISTURE RESISTANT PROPERTIES PREVENT CORROSION

By A. COOPER,
Expanded Rubber Co. Ltd.

A DICTIONARY definition of corrosion is the slow wearing away of solids, especially metals, by chemical attack.

The most active corrosive ingredient is atmospheric oxygen either with, or without, the presence of moisture. The problem of corrosion is as old as the earth itself, but surprisingly enough, resistance to this relentless foe has only been properly organized in this century. Among the many remedial measures adopted, rubber is playing a significant part. The use of the natural or synthetic polymers, either on their own or blended with rubber-like materials, or in the form of chlorinated rubber, is well known in the paint industry and many types of coating materials in solution and emulsion form have been described in technical literature.

Two lesser known methods of corrosion prevention will be described, both arising from the fact that rubber possesses an astonishingly low water absorption and water vapour transmission. These properties are retained even when the rubber is cellular, providing the cell structure is a closed one. Cellular rubber, having this non-communicating cell structure, has been termed expanded rubber, and it is available in two basic forms, rigid ebonite and flexible soft expanded rubber. Both these materials have been, and are being, used to prevent corrosion.

Expanded Ebonite

Expanded ebonite has been known since 1909, and is extensively used for low temperature insulation, buoyancy purposes and as a core material in sandwich construction. In all these applications, owing to its inert chemical nature, it does not corrode, and on account of its exceptionally low water vapour transmission it prevents moisture getting into cold stores and chemical plant. It is, however, necessary to examine the related properties, some of which are shown in Table 1.

Moisture Content

Although still water is a poor conductor of heat, the presence of moisture in a thermal insulation material can increase its conductivity quite appreciably. Thus, for example, it has been found by experiment that cork at a 7.7lb./cu. ft. density, with a water content of 49%, has its thermal conductivity increased from 0.31 BTU/sq.ft./hr./°F./in., to 0.37 BTU/sq.ft./hr./°F./in., measured at 39°F.

In all the thermal conductivity measurements on cork, the sample is as free from moisture as possible, but in actual use in an atmosphere of a high relative humidity, cork readily takes up moisture and its thermal conductivity may then no longer be that which is claimed.

Cork board, unless specially dried, has a natural moisture content of between 3 and 8% by weight. This is certainly better than that of some insulation materials, but the aim should be to keep this figure as low as possible, and as constant as practicable.

Expanded ebonite has a maximum natural moisture content of 1.3% by weight at a relative humidity of 72%. Its unique cell structure and chemical inertness are the main contributing factors to this astonishing result.

TABLE 1
PROPERTIES OF EXPANDED EBONITE

Standard density (nominal):	4lb./cu.ft.
Thermal conductivity:	0.20 BTU/sq.ft./hr./°F./in. at a mean temp. of 50°F.
Water absorption:	1.5% by vol. after six weeks' total immersion
Water vapour transmission at 100°F. and 1—90% relative humidity:	1.58gr./sq.ft./24hr./2in.
Coefficient of linear expansion:	0.000028 per °F.
Maximum recommended temp.:	122°F.
Specific heat:	0.33 at 73°F.
Compression strength (ultimate breakdown load):	40lb./sq.in.
Tensile strength:	35 to 45lb./sq.in.
Impact strength:	0.1ft.lb. on ½in. × ½in. unnotched Izod at room temp.
Modulus of elasticity in compression:	2,500lb./sq.in.
Resistance to chemicals:	Resistant to all dilute acids and concentrated alkalis, but not to oils and solvents. Will stain all paints containing lead and cadmium.
Odour:	Hydrogen sulphide when freshly cut.
Inflammability:	Self-extinguishing. Passes BS 476/1932, classification 3, and BS 2782. Part 5, 1958.
Carbon dioxide transmission:	10.1cu.in./sq.ft./24hr./in. Hg/2in.

Moisture Vapour Absorption

Moisture vapour absorption, as distinct from water absorption, is the amount of moisture a material will

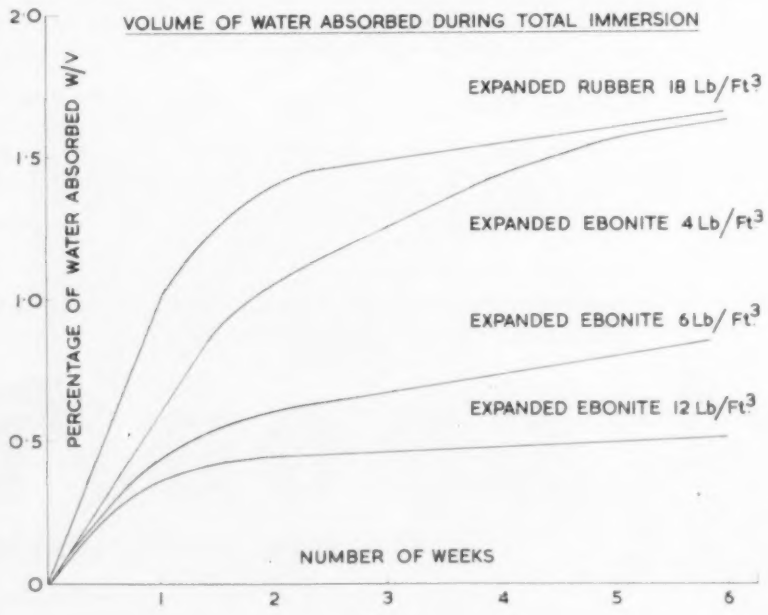

Fig. 1

absorb when exposed to an atmosphere of high relative humidity. In some ways the resistance of an insulating material to moisture vapour absorption may be even more important than its resistance to water absorption, as water is not necessarily always present, whereas water vapour cannot be avoided in any circumstances.

Fig. 1 shows the amount of moisture vapour taken up over a long period, of three grades of expanded ebonite and one of expanded rubber. In order to make the results independent of density, they have been expressed as the volume of water absorbed per volume of material. In all cases, the tests were made using a 100% relative humidity at 18°C.

Moisture Vapour Transmission

Apart from the thermal conductivity of an insulation material, its moisture vapour transmission is probably the most important property. It may have an excellent K factor, low moisture vapour absorption, low capillarity, and a low water absorption, but unless these properties are coupled with a low moisture vapour transmission through the material, it will be of very little use if insulation efficiency and performance are expected. It is for this very reason that so much energy has been devoted to the development of really good vapour barriers, and there is hardly a cold store anywhere in the world where bitumen is not used in some form or other.

Building materials have a wide range of moisture vapour transmissions, as will be seen from Table 2. These results have been drawn from various lists of properties published in technical literature, but are, strictly speaking, not necessarily directly comparable, as the test methods differ from one laboratory to another. They are, however, a useful guide, and serve to show the relative merits of most materials of construction, and throw into relief the outstanding properties of bituminous and rubber materials.

It is important to have more accurate, that is to say more directly comparable results, when comparing materials used for thermal insulation purposes. The results in Table 3 are therefore more significant, as they show the moisture vapour transmission figures obtained under identical test conditions, by one laboratory. The author is indebted to the Printing, Packaging and Allied Trades Research Association, Leatherhead, for permission to publish the results.

The test method is as follows: A specimen 2.6in. in diameter and 2in. thick is cut from the sample with a band saw and after conditioning for 24 hours at the test conditions is put in a glass beaker 2.6in. in diameter. The beaker contains a quantity of anhydrous calcium chloride thus ensuring a relative humidity of between 0 and 1% RH on that side of the test specimen. The test specimen is sealed into position by means of a template and wax, giving an exposed area of 25sq. cm. The whole assembly is weighed and placed in a tropical test chamber maintained at conditions of 38°C. and 90% relative humidity. Weighings are then carried out at intervals until a sufficient number of readings have been obtained to draw a straight line through a minimum of three points, not including the point of origin. From this graph, the moisture vapour transmission rate of the material is calculated in gm./sq. m./24 hours. (The method is a modification of that given in the Packaging Code BS 1133/1952, Section 7, Appendix E, page 139.)

For the sake of convenience the results are expressed for 2in. thick boards, as this is a standard thickness in the thermal insulation industry.

The results for Onazote expanded ebonite are of particular note as they give an outstanding figure of 1.1gm./sq.m./24 hours, which is the same as that for a ½in. thick coat of bitumen. The implication of this can be readily followed, since bitumen is generally used as a vapour barrier and with the introduction of Onazote it is now possible, for the first time in the history of the industry, to insulate with a material as good as the vapour barrier. In many cases, a vapour barrier in the traditional sense of the word, may be dispensed with, although it is still necessary to seal all joints between the boards.

Cork, under the same test conditions, gives a surprisingly high result, although it is credited with a low capillarity, showing the danger of relying on one test only.

Unfortunately, there is at present no international or national agreement on the units expressing moisture vapour transmission, and many different expressions are met with in technical literature. These units can, of course, be converted to other units as required, but test methods vary widely, and the results of such conversion would be somewhat misleading unless the test methods were known.

Water Absorption

The water absorption of an insulating material is as important as its water vapour transmission, but unless the test method is specified the figure can vary quite considerably.

The test pieces for the results shown on the graph in Fig. 1 were all 3in. by 3in. by 2in. thick, and with the natural skin removed on all edges.

The water absorption of light density materials is usually expressed as percentage volume of water absorbed, as otherwise the effect of the lighter density would give quite misleading results. There are other factors to be taken into account when carrying out water absorption tests:

(1) If a large sample is used, the water absorption expressed by volume would be lower. The impor-

TABLE 2
MOISTURE VAPOUR TRANSMISSION THROUGH VARIOUS BUILDING MATERIALS

Material	Thickness	Gm./sq.m./24 hr./mm. Hg	Gm./sq.m./24 hr. at 38°C. and 1—90% R.H. gradient
Hot-dip bitumen	One coat	0.34	15.1
Bitumastic paint	Two coats	0.54	24.5
Bitumastic paint	One coat	2.22	98.0
Seal coat paint	Two coats	0.74	33.3
Paint (flat oil base)	Two coats	1.13	49.2
Aluminium paint	One coat	1.49	65.9
Aluminium paint	Two coats	1.17	52.0
Asphalt emulsion	0.32cm.	1.54	68.3
Paint (white, flat, oil base)	Two coats	1.71	75.9
Concrete (1 : 2 : 4)	25.7cm.	1.89	83.5
Plaster	1.27cm.	10.7	473
Asbestos/cement board	0.32cm.	10.6	467
Fibreboard	0.51cm.	43.2	1,910
Wood (pine)	2.03cm.	0.61	27.0

TABLE 3
MOISTURE VAPOUR TRANSMISSION OF THERMAL INSULATION MATERIALS

Material	Density, lb./cu.ft.	Thickness, in.	Transmission in gm./sq.m. 24 hr. at 38°C. and 1—90% R.H. gradient
Bitumen	—	0.1	1.10
Onazote (expanded ebonite)	4	2	1.10
Polyzote (expanded polystyrene)	1	2	50
Polyurethane (rigid)	11.5	2	52.0
Cork board (baked)	14.4	2	88.0
Cork board	9	2	240.0
Cork board	10.5	2	340.0

tance of a standard test piece cannot be over-emphasized.

(2) The depth of immersion into water is important. The deeper the immersion the greater the water

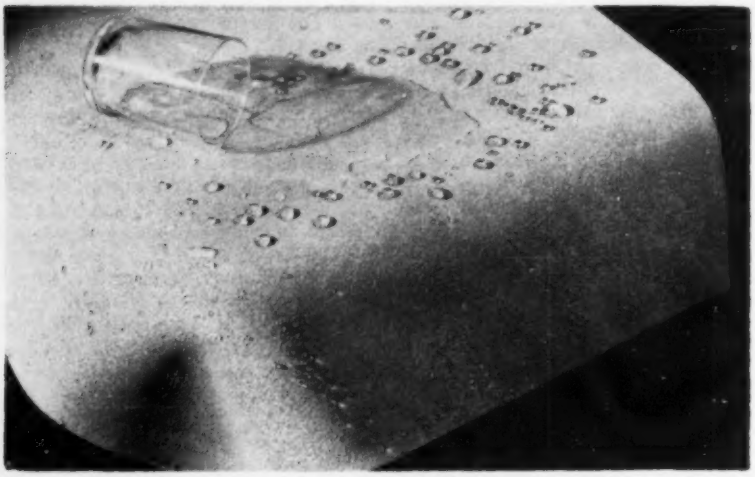

Fig. 2. The water-repellant properties of soft expanded rubber are partly responsible for its very low water absorption

absorption, on account of the head of water tending to force the water into the test piece. In the tests expressed graphically all test pieces were immersed not more than 1in. below the surface.

(3) The temperature of the water is important. The tests referred to have been carried out between 15° and 20°C. The higher the temperature the greater the water absorption.

(4) The method of wiping the sample after immersion and before weighing can influence the result, and is therefore rather an important point. Owing to the cellular surface, it may be quite difficult to reproduce the identical conditions at each test. The sample may be shaken free from water; it may be wiped with a cloth; it may be centrifuged; or it may be tapped on blotting paper. In the results quoted, the latter method has been used, as it seems to give the most reproducible results.

Onazote expanded ebonite has very low water absorption; 1½% by vol. after six weeks' total immersion, and it has been ascertained experimentally that even after 2½ years of total immersion, the water absorption is only 4½%. For this reason, expanded ebonite is used by the Admiralty as a buoyancy material for carrying the boom defences.

Condensation

Thermal insulation materials are frequently used to reduce or to prevent condensation of moisture on structural surfaces. This is a property which is directly related to the thermal conductivity of the material, but as this survey deals with properties related to the resistance of insulated material to water, a reference to condensation would not be out of place. Condensation of moisture on structural surfaces depends upon: the external temperature; the relative humidity of the outside air; the air temperature within the building; the relative humidity of inside air; the thermal transmittance of the structure; the position of the vapour barrier in the building construction.

The best method of preventing condensation is to ensure that the thermal insulation of the building construction is adequate for the conditions. Table 4 shows the thermal transmittance at which condensation can be prevented under the conditions stated.

Thus, for an outside air temperature of 30°F., and an internal temperature of 70°F., and relative humidity of 50%, the thermal transmittance of the building construction should not exceed 0.7 BTU/sq.ft./hour/°F.

TABLE 4

RELATIONSHIP BETWEEN THERMAL TRANSMITTANCE AND PREVENTION OF CONDENSATION

Outside air, °F.	Inside air: Temp., °F.	Inside air: Maximum relative humidity	To prevent condensation thermal transmittance U must not exceed
30	50	97	0.1
	70	92	
	90	90	
30	50	82	0.4
	70	70	
	90	62	
30	50	71	0.7
	70	54	
	90	43	
30	50	62	1.0
	70	42	
	90	29	
30	50	53	1.3
	70	30	
	90	18	
30	50	45	1.6
	70	22	
	90	12	

For surface condensation, the position of the thermal insulation in the wall is not so important, but in control of internal sweating in light insulated construction the position of the vapour barrier is critical. The amount of condensation that can take place within a wall construction depends upon the resistance of intervening materials to vapour transfusion, differences in vapour pressure and the duration of the pressure gradient.

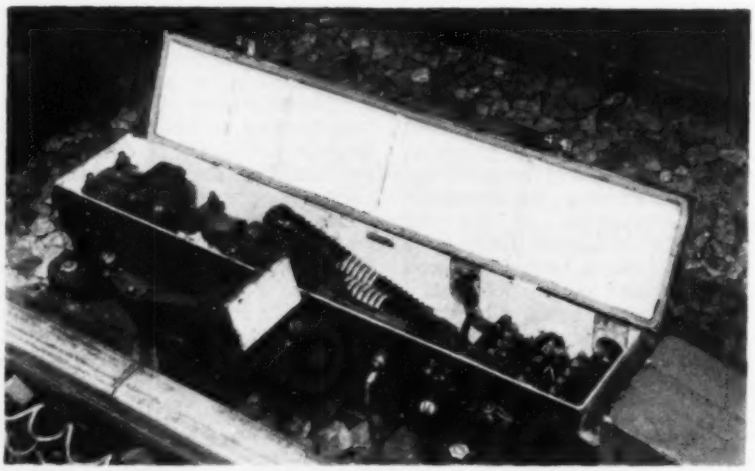

Fig. 3. Automatic signal relay box used by British Transport Executive on underground railways. A soft, expanded rubber strip provides a waterproof, dustproof seal

High vapour pressures are associated with high temperatures and high relative humidities. Low vapour pressures always exist at low temperatures even though the humidity is high.

Thus to prevent condensation within built-up wall construction, it is desirable to have a vapour barrier on the side of the higher temperature,

that is, usually just behind the internal wall finish.

The barrier resists the passage of moisture while it is in the form of vapour and thus prevents condensation within the structure of the wall.

Many examples of the use of expanded ebonite to prevent condensation, and therefore corrosion, can be given. A recent case is that of buses supplied to London Transport, the roofs of which are produced in one piece comprising $\frac{3}{8}$in. expanded ebonite core faced externally with aluminium sheeting, and internally with $\frac{1}{16}$in. plywood. Condensation from the roof is prevented and hence corrosion of the metal parts is not possible.

Another example is the 'Phantom' caravan, made by Coventry Steel Caravans Ltd., in which $\frac{1}{4}$in. thick expanded ebonite is used faced with decorative wood veneer, resulting in a corrosion-proof structure, giving a better appearance and longer life to the structure which is subjected to much wear and tear under exacting conditions.

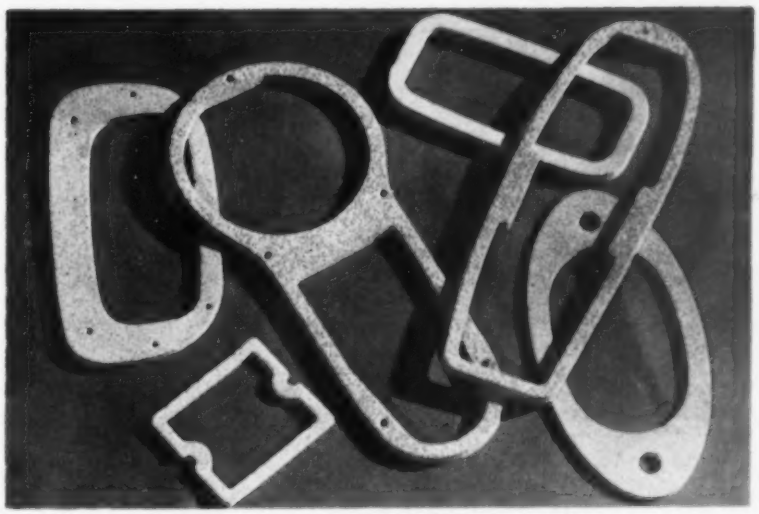

Fig. 4. Soft, expanded rubber pads are used extensively in the car industry as gaskets and sealing rings

Soft Expanded Rubber

The flexible or soft expanded rubber, as distinct from ebonite, is an even older product than its rigid counterpart. It possesses useful physical properties, as shown in Table 5, and of particular importance in its application is its low water absorption. Fig. 2 shows how the water is repelled. This property is being used in many industries today where expanded rubber is constantly finding new applications, both in packaging, in gasketing and as a space filler to prevent the ingress of moisture and hence preventing corrosion.

Packaging

The production of all classes of goods in transit raises problems to which, in many instances, only expanded rubber can offer a wholly satisfactory solution. Light in weight, resilient, shock absorbing, and proof against moisture, expanded rubber provides a sure and practical method of protection, for example, the cushioning of delicate instruments or

Continued on page 480

TABLE 5
PROPERTIES OF SOFT EXPANDED RUBBER

	Industrial grade 10—14lb./cu.ft.	Standard density 16—22lb./cu.ft.	Heavy density 26—36lb./cu.ft.	Light density 10—12lb./cu.ft.
Compliance with specification				
Normal	Not to specification	Ministry of Aviation CS 2808 and Admiralty K1326F (Type MS)	Admiralty K1326F (Type M.H.)	Ministry of Aviation CS 28082 and Admiralty K1326F (Type MS)
Non-silver staining	—	RCS 1000 CS 2755B DEF 5000	— — —	RCS 1000 CS 2755B DEF 5000
Tolerances				
Below $\frac{1}{2}$in. thickness	+10%—12½%	+10%—10%	+7½%—7½%	+5%—12½%
$\frac{1}{2}$—1in. thickness	+10%—10%	+10%—5%	+5%—5%	+10%—7½%
Length and breadth (on a 3ft. × 2ft. sheet)	+2in.	+1½in.	+1½in.	+2in.
Shrinkage on cutting	5%	3%	3%	5%
Compression/deflection (static loading)				
Approx. load to compress by 10%	6lb./sq.in.	6lb./sq.in.	8lb./sq.in.	6lb./sq.in.
Approx. load to compress by 25%	10lb./sq.in.	11lb./sq.in.	15½lb./sq.in.	10lb./sq.in.
Approx. load to compress by 50%	25lb./sq.in.	33lb./sq.in.	45lb./sq.in.	25lb./sq.in.
Compression set (average figures)				
40% compression for 70 hr. at room temp. ½ hr. recovery	1—½in. thick 8% below ½in. 15%	1—½in. thick 10% below ½in. 20%	1—½in. thick 4% below ½in. 8%	1—½in. thick 8% below ½in. 15%
25% compression for 48 hr. at room temp. ½ hr. recovery	1—½in. thick 5% below ½in. 8%	1—½in. thick 6% below ½in. 10%	1—½in. thick 2% below ½in. 3%	1—½in. thick 5% below ½in. 8%
Maximum recommended static loading at room temperature	1½lb./sq.in.	2lb./sq.in.	10lb./sq.in.	1½lb./sq.in.
Lowest recommended working temperature	—76°F.	—67°F.	—58°F.	—76°F.
Lowest temperature of failure	—94°F.	—85°F.	—76°F.	—94°F.
High-temperature resistance				
Continuous	113°F.	113°F.	113°F.	113°F.
Intermittent	149°F.	158°F.	158°F.	149°F.
Thermal conductivity	0.32 BTU/sq.ft./hr./°F./in. at a mean temp. of 48°F.	0.45 BTU/sq.ft./hr./°F./in. at a mean temp. of 48°F.	0.50 BTU/sq.ft./hr./°F./in. at a mean temp. of 48°F.	0.32 BTU/sq.ft./hr./°F./in. at a mean temp. of 48°F.

CORROSION and INSULATION

Organized Resistance

INDUSTRIAL ANTI-CORROSION SERVICES

NO-ONE would deny that one of the major factors in the overhead running costs of almost any industrial concern, however small, is the need to combat or prevent corrosion.

This may take the form of a regular bill for paint and labour to apply it, or, for a large concern, may run into thousands of pounds spent in a multitude of ways from paint to piping, coatings to cathodic protection.

The causes of corrosion may be divided roughly into two groups which could perhaps be classified as internal and external, external being those causes resulting from uncontrollable environmental conditions and internal causes arising from the corrosive nature of the products being handled.

New Possibilities

While the problem of corrosion, particularly from atmospheric and other environmental causes, is as old as the world itself, the means of combating it are still in their infancy and have not, until comparatively recently, been other than rather haphazard attempts.

With the advent of rubbers, plastics and other synthetics, the corrosion resistant properties of which were quickly realized, the number of ways of preventing deterioration have rapidly increased as also has the need for organizing some method of informing industrial organizations of the means at their disposal to solve their problems in this direction.

Because of the advent of new materials and the development of new techniques, many companies have organized their experience and resources and set up services to their customers designed to offer practical assistance to all in industry concerned with the handling of corrosive materials.

Pipes and Fittings

BTR Industries for instance, which has long made a speciality of the lining and covering, with rubber and ebonite, of all kinds of industrial equipment, has a specialized corrosion engineering service intended to advise on the use of the rapidly increasing number of products of the company. These include, apart from the rubber and ebonite linings mentioned above, many other plastics products such as the range of pvc pipes and fittings known under the trade name Silverflow, polypropylene pipes and ptfe lined hoses, pipes and fittings. A range of coatings has also been developed in neoprene, Hypalon, nitrile rubber, Viton, epoxies and pvc and, in conjunction with Gewerkschaft Keramchemie, the BTR service has been extended to embrace the design, supply and erection of chemical and corrosion resistant plant and equipment.

Technical Advice

The Dunlop Rubber Co., General Rubber Goods Division and their associated company Semtex Ltd. operate a similar service which, as well as supplying corrosion resistant materials backed by technical service to advise on their use, employs a nation-wide contracting organization experienced in this type of work.

Included among the Semtex products are corrosion resistant floor surfaces, tank and coal bunker linings and process vessels, and paint type coatings. Dunlop specializes in plant linings and can vulcanize vessels up to 15ft. in diameter and 40ft. long in a wide range of materials including natural and butyl rubber, neoprene, Hypalon and hard rubber. A recent development has been the production of a composite layer of polythene or polypropylene and rubber chemically bonded together which may be applied to metal surfaces using the rubber backing as the bonding layer. Linings of pvc and glass reinforced resin structures are also provided and the range of products is completed by solid rubber utensils and fittings, protective paints and acid resistant clothing, hose and belting.

Reinforced Plastics

Reinforced plastics obviously have a tremendous potential in this field, and among firms already using them are Tough Plastics Ltd., who make large tanks and pipes with diameters running into feet by using a welded pvc structure coated with a glass/polyester material to confer good mechanical strength. Bristol Aeroplane Plastics high pressure Epoch pipe is intended for high pressure lines and is constructed on a highly automated plant from glass fibre and epoxy resin to give the necessary strength, and has an acrylic lining to improve chemical and abrasion resistance.

There are obviously many other companies engaged in the battle against corrosion, and as newer and more versatile materials are developed the number of firms who will be able to offer a service similar to that supplied by BTR and Dunlop will certainly increase.

EXPANDED RUBBER Continued from page 479

apparatus throughout long journeys anywhere in the world. Being impervious to moisture, and to micological attack, it can be effectively used in any part of the world. Its closed cell structure prevents water ingress, and it can therefore be used either inside or outside of polythene wrapping film so that even the most delicate metal parts of a complicated instrument can be safely transported without the risk of corrosion.

Gasketing

Expanded rubber gaskets, fabricated from sheet material, are suitable for dust, air and water seals in instrument cases, switchboxes and similar applications in industry. By keeping moisture out corrosion is prevented. Fig. 3 shows an automatic signal relay box as used by British Transport Executive on Underground Railways. The lid is fitted with an expanded rubber gasket to provide a weatherproof and dustproof seal.

Space Filling

A further application of expanded rubber for filling spaces where moisture is likely to collect, and hence by excluding such a source of corrosion it performs a vital function. Fig. 4 shows a selection of pads used in the motor-car industry as gaskets and sealing rings, and as a space filling matrix.

Where necessary these products can also be obtained in expanded neoprene which, in addition to the other properties of expanded rubber, is resistant to petrol and oil and is capable of operating at high temperatures, and also shows better ageing properties. One of the latest additions to the range of materials available is expanded silicone rubber.

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CORROSION and INSULATION

Neoprene Coatings and Hose

DESIRABLE COMBINATION OF PROPERTIES

NEOPRENE, and its newer companion 'Hypalon' synthetic rubber, are being put to use in many industries to help solve numerous corrosion problems as coatings for metals and a number of other materials. Neoprene offers an unusual combination of desirable properties, including excellent resistance to sunlight, weathering, corrosive atmospheres, oil and grease, and most chemicals but darkens gradually on exposure. 'Hypalon' costs more than neoprene and is used for more specialized coatings. It has excellent colour stability and coatings in any colour or shade are feasible, it is completely resistant to ozone and has outstanding resistance to strongly oxidizing chemicals. Its heat resistance is also somewhat higher than neoprene and neither elastomer will support combustion.

Propulsion Shafts

One of the fastest growing uses of these elastomers today is in the shipping industry. The US Navy has been using neoprene coatings for the propulsion shafts exposed to sea water and on oil tankers, both old and new valves are being coated with $\frac{1}{16}$in. of neoprene to prevent corrosion and pitting. Elbows which pitted and spurted water after little more than a year's use are lasting much longer after being lined with a coating of neoprene. The pump room sea chest on these tankers also is being painted with brush-on neoprene. Here it is put to a severe test as it is exposed to corrosion by raw sea water and when ballast and tank washings are pumped through, is subjected to sea water mixed with various petroleum products.

Hypalon too, has excellent potential as a coating material for ships, particularly where protection plus beauty is desired. Fabrics coated with Hypalon and neoprene-coated fabrics, are being used to replace the canvas tarpaulins so frequently used on board ship. These have excellent resistance to weather and abrasion and, unlike canvas, remain flexible in sub-zero weather and resist damage by mildew and other micro-organisms.

One of the most outstanding examples of the durability of neoprene is a hose which has been used on a molasses tanker for a quarter of a century. This hose is put to a rugged test once a year when it feeds 11,200 tons of molasses to the ship in a 34hr. operation off the coast of Hawaii. Put together in 25ft. sections, it is chained to steel drums to keep it afloat. When it is not in service it is stored in an open shed where it is subjected to weather of all types — ozone, salt spray, and sunlight — and is still in good condition.

In chemical and related industries, synthetic rubbers are being used effectively as protection against corrosion, both for tank linings and hose and piping applications where good chemical resistance is vital.

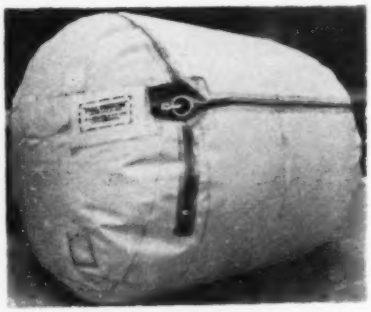
For the past few years neoprene has been used in uranium processing as a lining for tanks handling the corrosive leaching and ion exchange solutions used in the continuous purifying process.

The true cost of a protective coating is not the cost per gallon, but rather the applied cost and its effective life.

In the quarter of a century neoprene has been in existence, it has proved to be a valuable material for use under corrosive conditions.

PROTECTING ENGINES

A lightweight cover called Polykoon, which protects against corrosion, has been developed by the R. A. Brand Ltd. team responsible for the 'Texikoon' engine cover now standard in the RAF.



This cover, of a special weave glass cloth embedded in polythene, is said to be a high performance moisture vapour excluding membrane of immense strength. It is fitted with self-sealing slide fastener, pressure relief valve for air freighting and inspection windows, and it is made up by a new process of extrusion welding developed by Brands.

Its primary use is in the protection of aero engines, guided missiles and electronic equipment.

PREVENTING CHEMICAL ATTACK Continued from page 474

action of the acids. A motor-driven centrifugal pump in rigid pvc is illustrated in Fig. 2. This pump has an output of approximately 50 gallons a min. against a head of 50ft. and is used in industrial installations for the conveyance of acid or alkaline solutions.

The washing of corrosive fumes is a recurrent problem in the chemical industry and the mixture of liquid and gaseous materials presents special corrosion problems. A large size fume washer is being made which is fitted with four individual spray nozzle sections; the spray liquid, for instance ammonia, being pumped by means of two centrifugal pumps and circulated subsequently. The tower is fitted with a layer of polythene packings and is capable of washing gas at the rate of 8,000cu.ft. per min.

Fume extraction in the chemical industry has benefited to a considerable extent from the use of thermoplastics. Fig. 3 shows a section of rectangular pvc ducting for the extraction of fumes from the new radio chemical laboratory of the National Physical Laboratory, Teddington. Detachable pvc fume hoods can be connected to this system at strategic points.

These few examples illustrate the large number of applications which have been found for thermoplastic materials in the chemical and allied industries. They also show that the design of plant in plastic materials, which has only become possible in the course of the last ten years or so, has certainly made considerable strides.

Packing Cooling Towers

A corrosion resistant plastic packing called Polygrid has been developed for cooling tower installations. It is a moulded unit 3ft. square; units staggered in layers throughout the packing height of the tower break up hot water into droplets as it cascades over the packing. This type of packing therefore gives both splash and film-type cooling.

This packing is used extensively in Head Wrightson-Fluor 'Counterflo' Cooling Towers, but Head Wrightson Processes Ltd. is also installing it in established mechanical or natural draught towers of all types.

The packing is available in high impact polystyrene for resistance to water, acids, salts and alkalis, and in high density polythene for water contaminated by aromatic hydrocarbons.

Plantation Share Survey

SOGOMANA MERGER PLAN GOING THROUGH

BATTLE over . . . and the Sogomana group merger plan has attracted satisfactory support. Acceptances have reached over 70½% of the issued capital of SHELFORD RUBBER, 90.9% of SOGOMANA RUBBER and 86.9% in respect of TROLAK ESTATES. Lists are to remain open and there is every indication that in due course the three companies will become fully owned offshoots of the new group undertaking. In view of the satisfactory exchange terms, a considerable measure of success can easily be foreseen for the latest STRAITS RUBBER offers. In respect of the bids, both BADENOCH RUBBER — holders of which are able to exchange into STRAITS RUBBER on a seven-for-four basis — and BAGAN SERAI RUBBER — two Straits plus 3d. cash for every share held — have both had their market quotations marked higher.

The third party included in the plan, PALOH PLANTATIONS, is a private concern and in this case an adequate response can be anticipated since the issued capital is largely held by associated companies. If the operation is successful the issued capital of Straits Rubber will be doubled at £2,219,460, while the group's planted areas will total just under 36,000 acres of rubber capitalized at £62 per acre.

Still in the takeover field, the offer by HIGHLANDS AND LOWLANDS for EDINBURGH RUBBER has now been declared unconditional. The offer of two Highlands and Lowlands, plus 1s. cash for each Edinburgh unit remains open until March 27. The issued capital of Highlands will now be increased to £2,373,827. The group now owns planted areas of 47,769 acres of rubber and 11,235 acres of oil palms. The company's forecast of a final payment to shareholders of not less than 27½% making 40% for the 1960 trading year still holds good.

In the past month under review some of the leading rubber plantation companies have issued their reports for the 12 months to October 31 last. PATALING RUBBER, one of the old stagers of the industry which still maintains a leading role, disclosed that it had substantially extended its field of activities in the past year or so. This had been achieved by the acquisition of two large rubber concerns. While continuing with the modernization of the rubber areas, the Board said that it intended to expand the group's interest in palm oil, as at present prices it was more profitable than rubber.

The rubber largely processed at premium grades gave a net return of a fraction over 2s. 6d. per lb., while estate costs worked out at a fraction over 1s. 6d. per lb. including 5.4d. for export duty and cess. From the profit of £1,182,500 the dividend of 60% knocked off £425,700 while tax took even more at £426,400.

H. B. E. Hake, the chairman of Pataling, warned that the fall of 8d. per lb. from the 1959/60 average was bound to affect profits this year, but, given the continuation of settled conditions in Malaya and lower production costs as average yields are further influenced by the maturing of areas replanted with the best modern stock, natural rubber can effectively compete in price with synthetic. This view of Mr Hake's was coupled with a confident forecast that his company should be well able to give good account of itself in the years to come.

P. A. Rogers said at the annual meeting of GEDONG (PERAK) RUBBER ESTATE that, with the better prices ruling during the year under review, the company's 'all in' cost of production rose by 13% due to increased wages, higher export duty and so on. The margin of profit was enhanced by record crop of 529,500lb. harvested, and this was obtained despite one-third of the estate being immature and out of production. Mr Rogers noted the fact that demand for all grades of rubber has decreased. And he added 'The immediate future offers little or no likelihood of improvement but we have seen sudden upsurges in the past and once again we may not be disappointed'.

Plantation Newsletter

RRIM LARGEST ONE CROP RESEARCH BODY IN THE EAST

by our Malayan Correspondent

SOME of the work being done at the Rubber Research Institute of Malaya was reviewed by the secretary to the institute, J. C. Reeves, in a talk to the Kuala Lumpur Rotary Club, when he pointed out that the RRIM is the largest research body in the East specializing in one crop. The claim is founded on a budget of $12m. this year, and the fact that it now employs about 50 senior officers, both Malayan and expatriate, and about 700 junior staff, including rubber instructors.

Referring to the work done by the institute's divisions, Mr Reeves said that the Botany Division had achieved results of great practical importance from the work on breeding and the study of families of seedlings derived from high-yielding parent clones. The modern high-yielding clones gave an average throughout Malaya today of 1,500lb. an acre. There had been talk of 3,000lb. an acre clones but he was inclined to take this 'with a pinch of salt'.

One of the latest developments, said Mr Reeves, had been the establishment of a unit in Trinidad, British West Indies, to study the establishment of clones resistant to South American Leaf Blight (Dothidella Ulei). They dreaded the appearance of the disease in Malaya and had so far crossed budwood from resistant trees from Brazil with known high-yielding Far Eastern clones, and an attempt was now being made to see whether these clones were resistant.

The Chemistry Division, he said, was at present engaged in the examination of microscopic particles other than rubber found in latex, and was investigating the chemical processes by which rubber was made in the tree. Technical classification of rubber, connected with the division, had progressed in the last few years, and about 30,000 tons of TC rubber were being produced every year. Shipments of Superior Processing rubber in 1960 had totalled 2,828 tons, and this figure was steadily increasing. Other modified special rubbers were coming forward, such as a type that did not harden in storage. With latex, low ammonia latices were now being produced which formed 20% of the total Malayan shipments.

The Smallholders Advisory Service, he added, was in many ways the most important division of the institute. It was estimated that the average smallholding was about 4½ acres, and that most of the 1,600,000 acres of smallholding rubber was planted with old seedling rubber which averaged about 2lb. of dry rubber a day. Costs of production were small, as a smallholding was usually run on a family basis and the net profit was about £93 a year for the average smallholding.

Retiring Planters

After being connected with the rubber industry for more than 30 years, one of Malaya's best-known planters, J. C. Mathison, has left Malaya on retirement. It will be recalled that Mr Mathison resigned recently from the Rubber Producers' Council because of 'pressure' brought by the Government after he had severely criticized the supposed siting of the new international airport in such a way that it would encroach on RRIM experimental land.

Another well-known figure in the rubber industry, J. C. Stephen, director and planting adviser to Sime Darby Holdings Ltd., has also left Malaya on retirement after 35 years in this country. He first came to Malaya as an estate assistant and was made a visiting agent in 1947.

Rubber Markets

LONDON

Short covering was still the feature of an otherwise mainly dull market. Values were inclined to ease as buyers became less interested. Latterly they fell sharply in sympathy with a steep decline at Singapore. Factory interest was also slow throughout, but dealers took fair quantities of forward cif parcels.

Latest prices are as follows:

No. 1 RSS Spot: 25¼d. nominal.

Settlement House:

April 25⅝d.-25⅞d.

May 25½d.-25¾d.

June 25⅝d.-25⅞d.

April/June 25⅛d.-25⅜d.

July/September 25⅝d.-25⅞d.

October/December 25¼d.-25½d.

January/March (1962) 25¼d.-25½d.

No. 1 RSS cif basis ports:

April 24⅞d.-25⅛d.

May 24⅞d.-25⅛d.

Godown:

April 84¼ Straits cents nominal.

Latex

Centrifuged 60% latex per gallon in drums, seller, April, 14s. 7d., cif European ports. Spot, seller, 15s. 1d. Bulk, seller, d.w. 14s. 4d. Creamed, seller, 14s. 4d. nominal. Normal, seller, April, 12s.

NEW YORK

The New York rubber market ruled as under on March 20:

Dealers' Prices

	US cents per lb. ex-dock	
	Mar. 20	Previous
No. 1 RSS, April ..	30⅝n	30⅝n
May ..	30⅝n	—
No. 2 RSS, April ..	30⅜n	30½n
May ..	30½n	—
No. 3 RSS, April ..	30½n	30⅝n
May ..	30⅜n	—
No. 1 RSS, Spot ..	31⅛n	31n
No. 3 amber blanket crepe, April	—	—

Futures — Rex Contract

	March 20	Prev. Close
March ..	30.00b–31.25a	30.60n
May ..	31.10b–31.25a	30.60t
July ..	30.80t	30.15b–30.25a
Sept. ..	30.55b–30.70a	30.05b–30.10a
Nov. ..	30.45t	29.90b–29.95a
Jan. ..	30.30b–30.45a	29.75b–29.90a

Sales: 66. Tendency: Irregular.

Futures were firm on March 20, up about ½ cent per lb. Commission house buying was noted in fair dealings. November was a relatively active position. Physical rubber was quiet. Factories were showing little interest in offerings, traders said. In late trading, the spot month was irregular. The other positions held firm.

SINGAPORE

Dull conditions prevailed throughout the morning of March 20 after some initial steadiness. Profit-taking and short-covering were fairly evenly balanced. Trading was thin, due to upcountry centres being partially closed for the Muslim holiday. Lower sheets and off-grades were neglected. In the afternoon, the market got off to a slow start and prices advanced slightly on small buying and reserve of sellers.

	Malayan cents per lb., fob Malayan ports to open ports	
	March 20	Prev. Close
No. 1 RSS, April ..	89⅛–89½	89⅛–89½
May ..	88⅞–89⅛	88⅞–89⅛
No. 2 RSS, April ..	87½–88	87½–88½
No. 3 RSS, April ..	86½–87	86½–87⅛
No. 4 RSS, April ..	83 –84	83½–84½
No. 5 RSS, April ..	74½–75½	74½–75½
No. 1 RSS, Spot ..	88½–88⅞	88½–89
No. 3 blanket thick re-milled crepe, April	68½–69½	69 –70
No. 1 fine pale crepe, April	93 –94	92½–93½
2X thin brown crepe, April	68½–69½	68½–69

Tendency: Quiet but steady.

The Industries Syndicate quote latex, native produce, 60% centrifugal, packed in rectangular drums, fob at 175.00d. per gallon.

AMSTERDAM

The Amsterdam rubber market ruled as under on March 20:

No. 1 RMA	Guilders per kilo	
	Mar. 20	Previous
March	2.50	2.50
April	2.50	2.50
May	2.50	2.50
June	2.50	2.50
April/June	2.50	2.50
July	2.48	2.48

Sales: Nil. Tendency: Quiet.

DJAKARTA

Prices generally went up by 25 cents per kilo on March 21. No business was reported and the market closed steady quiet. Sheet No. 1 buyers was 25 cents above the previous final level at 32.00 rupiahs per kilo.

	Rupiahs per kilo	
	Mar. 21	Previous
Spot No. 1 priok ..	32.00b	31.75b
Spot No. 2 priok ..	31.00b	30.75b
Spot No. 3 priok ..	30.00b	29.75b
No. 1 fine pale crepe, spot	29.00n	29.00b

CEYLON

The price of No. 1 RSS at Colombo on March 20 was 110 (111½) Ceylon cents per lb.

BANGKOK

The price of No. 1 RSS at Bangkok on March 20 was 28.12½ (28.25) US cents per lb.

COMPANIES in the NEWS

British Nylon Spinners

Further progress was made in 1960 by British Nylon Spinners, whose £24m. one-class capital is jointly held by Imperial Chemical Industries and Courtaulds. The group trading balance rose from £10,465,832 to £11,521,338, after depreciation of £2,101,114 (£1,706,078).

With investment income of £173,005 (£88,827) and a profit of £90,310 (nil) on redemption of British Government securities, the balance is raised to £11,784,653 against £10,554,659. Tax takes £5,340,791 (£4,888,760), leaving a net profit of £6,443,862, compared with £5,665,899.

Dividends totalling 20% have been paid, as for 1959, but on capital increased by a one-for-three scrip issue, and require £2,940,000 against £2,205,000.

Northwestern Rubber

For the year ended December 31 1960 the net profit of Northwestern Rubber Co. Ltd. was £47,669 (£18,735) after tax of £8,163 (£5,910). An incorrect profit figure was stated in *RPW* March 11.

FBRAM DIRECT MEMBERSHIP SCHEME

Continued from page 454

Ltd.; Imperial Chemical Industries Ltd.; The International Synthetic Rubber Co. Ltd.; F. H. Lloyd and Co. Ltd.; Manchester Oil Refinery (Sales) Ltd.; Mantle Engineering Co. Ltd.; Micafine Ltd.; William Mills Ltd.; Monsanto Chemicals Ltd.; The National Standard Co. Ltd.; Northwestern Rubber Co. Ltd.; Philblack Ltd.; Polymer (UK) Ltd.; Robinson Brothers Ltd.; Joseph Robinson and Co. Ltd.; Rubber Regenerating Co. Ltd.; Francis Shaw and Co. Ltd.; A. Schrader's Son Division of Scovill Manufacturing Co.; Shell Chemical Co. Ltd.; Ship Carbon Co. of Great Britain Ltd.; Simon Handling Engineers Ltd.; Sinex Engineering Co. Ltd.; Alfred Smith Ltd.; Wilfred Smith Ltd.; Union Carbide Ltd.; Union Oxide and Chemical Co. Ltd.; United Carbon Black Ltd.; Waterside Mill Co. (Bury) Ltd. and Witco Chemical Co. Ltd.

PVC for Broilers

A growing tendency among owners of broiler houses towards installing small-bore pvc tubing in drinking water apparatus, instead of polythene tubing is claimed by the Compoflex Co. Ltd.

Future Events

Institution of the Rubber Industry

Manchester Section.—March 27 at the Engineers' Club, Albert Square, Manchester, at 6.45 p.m. 'Extrusion Productivity' by T. J. Daniel, BSc (RABRM).

Industry INTELLIGENCE

Technical Data

Nonionic Surfactants

Five new nonionic surfactants have been announced by Chemicals Department, Union Carbide International Company, 270 Park Avenue, New York 17, N.Y., for use in the chemical, paint, detergent, cosmetic, rubber, dry cleaning, and textile industries.

Tergitol 12-P-6 is a dodecyl phenol adduct with 6 mols of ethylene oxide. It is soluble in aromatic and aliphatic hydrocarbons and suitable for sulphation. Tergitol 12-P-9 is a dodecyl phenol adduct with 9 mols of ethylene oxide. It is soluble in aromatic hydrocarbons and can be used in place of nonyl phenol adducts containing 5 to 8 mols of ethylene oxide. Tergitol nonionic 12-P-12 is a dodecyl phenol adduct with 12 mols of ethylene oxide. It is a general purpose nonionic, completely water soluble.

Tergitol TMN-3, a trimethyl nonanol adduct with 3 mols of ethylene oxide, is soluble in aromatic hydrocarbons and slightly soluble in aliphatic hydrocarbons and mineral oil. Tergitol TMN-10 is a trimethyl nonanol adduct with 10 mols of ethylene oxide. This general purpose surfactant is also completely water soluble.

Supra Primrose

Supra Primrose Chrome 6GS is a new greenish yellow lead chrome pigment introduced by I.C.I. Dyestuffs Division. Claimed to have excellent weathering resistance it provides economical pigmentation of high-quality industrial finishes, in which it shows neither bleeding nor blooming, and has adequate heat fastness under the normal processing conditions. It has good resistance to darkening in full shades on exterior exposure, and the company says it represents a further advance over the Pure Primrose Chrome 16GS introduced by the Dyestuffs Division four years ago.

The pigment has been developed primarily for industrial finishes, but the company anticipates a 'substantial outlet in pvc and other thermoplastics'.

Corrosion Resistant Pipe Wrap

A new catalogue giving details about Fiberglas inner and outer underground pipe wraps, has been produced by Owens-Corning Fiberglas Corporation, and is available from OCF International SA, 717 Fifth Avenue, New York, N.Y.

Photographs, in colour and black-and-white, illustrate application techniques both on the job and in the mill.

Technical tables are included as a guide to the proper thicknesses, widths, laps, and other information necessary for specific applications. Dimensions, physical properties and other specifications of the pipe wrap products are included in the charts.

Both inner and outer pipe wrap products have been found after extensive tests to provide maximum coating strength and protection in all weather and soil conditions.

Fiberglas Coromat inner wrap, available in rolls up to 1,800ft., combines criss-cross glass fibres with parallel glass yarns to give rugged reinforcement to pipes. A reinforced glass mat with a bituminous saturant provides a tough but pliable outer sheath capable of withstanding temperature extremes without sticking or tearing.

Caloxol Rubber Desiccant

Porosity in vulcanized rubber has always been a problem, and is particularly acute when vulcanization is carried out under low pressure conditions.

Moisture is the primary cause of this porosity and when the fluid bed method of continuous vulcanization was being developed by RAPRA, several desiccants were tried in an attempt to reduce the moisture content of the rubber. Calcium oxide was found to be effective, but difficult to disperse. A dispersion of calcium oxide in mineral oil was found to overcome this problem and is marketed by John and E. Sturge Ltd., Wheeleys Road, Birmingham 15, under the trade name Caloxol.

Technical bulletin No. 5 gives the results of evaluation of Caloxol at the RAPRA laboratories which show that it is an effective desiccant for both natural and synthetic rubbers to control porosity due to moisture. The addition of 3-8 parts of Caloxol phr is in most cases sufficient to reduce porosity to an acceptable figure.

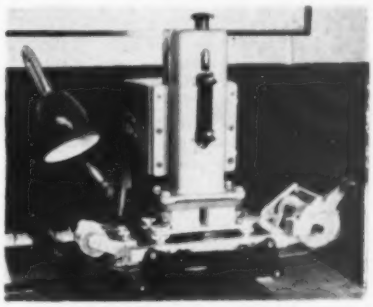
Machines, Materials and Equipment

High Frequency Welding Accessory

Radio Heaters Ltd. has introduced a new high frequency welding accessory which can be fitted to all small welders.

This accessory is a foil feeding device for gold embossing, blocking and other types of embossing foil applications. It consists of a sliding carriage on a rigid mounting frame, on which is carried a foil reel holder and a rewind reel, which is actuated through a ratchet drive from the operating handle.

The length of stroke of the operating handle can be set to effect a foil indexing feed length from 0–5½in., while reels of up to 3in. wide can be fed. Little foil is wasted, and the whole unit is retractable on its sliding



frame, thus allowing as a first operation, if required, the blanking of heavy grained pvc materials, while repositioning for embossing is claimed to be instantaneous, without any loss of positioning accuracy.

Publications

Polyester Pastes

A brochure issued by Llewellyn Ryland Ltd., Balsall Heath, Birmingham 12, describes the company's polyester colour pastes. The brochure includes a page of samples of the various shades.

Discoloration of Rubber

In the December 1960 issue of 'Transactions of the Institution of the Rubber Industry', there appeared an article called 'Influence of the Wavelength of Light (Solar Spectrum) on Discoloration of Rubber', written by A. G. Buswell, of I.C.I. Dyestuffs Division. I.C.I. has now reprinted the article as a booklet.

Aided by diagrams and tables, the article describes tests that have been carried out in order to study the effects of various parts of the solar spectrum on the development of discoloration of a white rubber compound. The results of several tests are given and the overall conclusion obtained from them is written concisely to complete the paper.

Polyurethane Foams

A paper called 'Polyurethane Foams: Methods of Production, Properties and Applications', by J. M. Buist, R. Hurd and A. Lowe, I.C.I. Dyestuffs Division, originally delivered at the annual general meeting of the Society of Chemical Industry at Bristol, was printed in the December 1960 issue of *Chemistry and Industry*. I.C.I. has now reprinted this article as a booklet.

The headings of the paper include: the physical characteristics of resins and isocyanates, the basic equipment for factory production, mixing methods and suggestions as to the best mixer available for use, and the actual manufacture of moulded articles. Information is also recorded on the testing of foams, and several applications of the finished product are given.

Material Prices

Prices of materials appear regularly in RUBBER AND PLASTICS WEEKLY on the ast Saturday of each month. It will be appreciated if suppliers will give notification of any price changes and additions to or deletions from their range. Comments on the present materials and classifications are invited in order that the list may be made of maximum service to our readers.

Unless otherwise stated prices are per lb. In most cases prices vary according to quantity. pc—per cwt pg—per gallon pt—per ton ag—according to grade xs—ex-store xw—ex-wharf dp—duty paid sp—special prices for contracts del—delivered cp—carriage paid

Accelerators

Alpha ..... 5s. 8d.—6s. 4d.
Ancap cp ..... 2s. 10d.—3s. 8d.
Ancap Zinc Salt cp ..... 3s. 2d.—4s. 2d.
Ancatax cp ..... 3s. 9d.—4s. 6d.
Ancazate BU cp ..... 6s. 3d.—6s. 9d.
Ancazate ET cp ..... 5s.—6s. 4d.
Ancazate ME cp ..... 6s. 2d.—7s.
Ancazate Q cp ..... 6s. 1d.—6s. 4d.
Ancazate XX cp ..... 5s. 1d.—5s. 9d.
Ancazide ET cp ..... 5s. 9d.—6s. 6d.
Ancazide IS cp ..... 7s. 6d.—8s. 6d.
Ancazide ME cp ..... 4s. 6d.—5s.
Cu D.D. ..... 9s. 3d.—10s.
D.Bu.D ..... 10s. 6s.—11s. 3d.
D.D.D ..... 12s. 2d.—13s. 3d.
D.P.G. cp ..... 3s. 5d.—4s. 2d.
D.O.T.G. cp ..... 4s. 5½d.—4s. 9d.
Dibenzo GMF ..... 27s.—28s. 6d.
Furbac cp ..... 5s.—5s. 9d.
Gamma ..... 10s. 6d.—11s. 3d.
GMF ..... 27s.—28s. 6d.
L.M.D ..... 9s. 3d.—10s.
M.Z.I ..... 3s. 6d.—4s. 2d.
N.Bu.D ..... 10s. 6d.—11s. 3d.
Ni.P.D ..... 12s. 2d.—13s. 3d.
P.P.D ..... 12s. 2d.—13s. 3d.
P.T.D ..... 12s. 2d.—13s. 3d.
Robac 22 ..... 10s.—11s. 3d.
Robac 44 ..... 9s. 1d.—9s. 10d.
S.P.D ..... 9s. 3d.—10s.
Suparac M ..... 9s. 7d.
T.B.U.T ..... 15s.—16s.
T.E.T ..... 6s. 6d.—7s. 4d.
Thiuram P.25 ..... 15s.—16s.
T.M.S ..... 7s. 8d.—8s. 6d.
T.M.T ..... 5s. 4d.—6s. 3d.
Vulcacit CZ deldp ..... 7s. 1d.
Vulcacit F deldp ..... 4s. 8½d.
Vulcacit NP deldp ..... 11s. 2d.
Vulcacit P Extra N deldp ..... 8s. 1d.
Z.B.E.D ..... 15s.—16s.
Z.Bu.D ..... 6s. 3d.—7s. 3d.
Z.D.C ..... 5s. 1d.—5s. 7d.
Z.I ..... 9s. 3d.—10s.
Z.P.D ..... 9s. 3d.—10s.

Antioxidants and Antiozonants

Agerite AK cp ..... 3s. 6½d.—4s. 5½d.
Agerite HPX cp ..... 4s. 5d.—4s. 10d.
Agerite Powder cp ..... 3s. 7d.—4s.
Agerite White cp ..... 8s. 10d.—9s. 7d.
Antioxidant 2246 cp .. 11s. 8d.—12s. 4d.
Antioxidant 425 cp .... 18s. 6d.—19s. 3d.
Antioxidant SP cp ..... 3s. 8d.—5s.
BLE-25 ..... 3s. 7d.—4s. 5d.
BXA ..... 3s. 6½d.—4s. 5½d.
Naugawhite ..... 4s. 9d.—5s. 6d.
Octamine ..... 3s. 9d.—4s. 6d.
Polygard ..... 3s. 7½d.—4s. 5d.
UOP 88 xs ..... 9s. 3d.
UOP 288 xs ..... 9s. 3d.
Wing-Stay S ..... 3s. 8d.—4s.
Wing-Stay T ..... 4s. 10d.—5s. 6d.
Wing-Stay 100 ..... 10s. 6d.—11s. 6d.

Compounding Ingredients

Barytes ptag ..... £10—£40
Calcium Silicate del ..... 9d.—10½d.
Calcene ptxw ..... £52—£69 10s.
Carbonate, Light Mg. ptsp £97
Carbonate, Actidated Ca. pt .... £28—£30

Carbon Blacks:

Conductex SCF ..... 1s. 2½d.
Continental AMPC ag 11½d.—1s. 4½d.
Continex FEF ag ..... 9½d.—10½d.
Continex HAF ag ..... 10½d.—11d.
Continex HMF ag ..... 9½d.—9½d.
Continex ISAF ag .. 1s. 0½d.—1s. 0½d.
Continex SRF, SRF-NS ag 8½d.—9d.
Dixie 45 GPF xs ..... 6½d.—7½d.
Dixie 60 HAF xs ..... 7½d.—8½d.
Dixie 70 ISAF xs ..... 9½d.—10½d.
Dixiedensed HM MPC xs ..... 11½d.
Dixiedensed 77 EPC xs ..... 11½d.
Furnex SRF ..... 9d.
Kosmos 45 GPF ..... 6½d.—7d.
Kosmos 60 HAF ..... 7½d.—8d.
Kosmos 70 ISAF ..... 9½d.—10d.
Magecol 888 cp ..... 7.60d.
Micronex MPC ..... 11½d.
Micronex W6 EPC ..... 11½d.
Philblack A. FEF ..... 7d.—8d.
Philblack E. SAF .... 1s. 0½d.—1s. 1d.
Philblack G. GPF ..... 6½d.—7½d.
Philblack I. ISAF ..... 9½d.—10½d.
Philblack O HAF ..... 7½d.—8½d.
Regal 300 ..... 7½d.—8d.
Regal 600 ..... 9½d.—10d.
Statex B. FF ..... 10½d.
Statex R. HAF ..... 11d.
Statex 93 HMF ..... 9½d.
Sterling SO FEF ..... 7d.—7½d.
Sterling V. GPF ..... 6½d.—7d.
Ukarb 327 GPF xs ..... 6½d.—7½d.
Ukarb 340 xs ..... 7½d.—8½d.
Vulcan 6 ISAF ..... 9½d.—10d.
Vulcan C CF ..... 11d.—11½d.
Vulcan 3 HAF ..... 7½d.—8d.
Vulcan XXX SCF .. 1s. 2½d.—1s. 2½d.
China Clay ptagxs ..... £12—£68 10s.
Factice Dark cp ..... 1s. 0½d.—1s. 7d.
Factice White cp .. 1s. 3½d.—1s. 11d.
Factice White ..... 1s. 4½d.—1s. 8½d.
Kieselguhr Spanish White ptxs £37 12s. 6d.
Lithopone 30% ptxs ..... £68 10s.
Manosil VN3 pt .... £120 5s.—£150 5s.
Micafine Powdered Mica ptxs .. £67 10s.
Ochre Yellow pcxs ..... £1 19s.
Oxide Light Mg ptsp £245
Oxide Red pcxs ..... £4 3s.
Oxide Titanium 98% pcxs £8 8s
Rutiox CR pcxs £9 3s
Rubber Gen. Gran. Mineral ptxs £35 5s.
Shellac Dewaxed xs ..... 1s. 9d.—2s. 3d.
Shellac Orange xs ..... 2s.—3s. 9d.
Silica Hydrated ptxs £113
Sulphur Manox Insoluble del .... 1s. 9d.
Sulphur Powdered ptdel ..... £20 17s.
Sulphur Sublimed Flowers ptxs £52 10s.
Talc Norwegian ptxs ..... £13 7s. 6d.
Talc Italian ptxs ..... £30 2s. 6d.
Tufknit Durham CS ..... 8½d.—10½d.
White Lead Dry ptdelsp ..... £112 5s.
Whitetex 2 Clay ptxs ..... £45 10s.
Whiting ptxs ..... £5 9s. 6d.—£7 7s. 6d.
Zinc Oxide pcdel £6

Plasticizers and Softeners

Abalyn pc ..... 220s.—271s.
Al Stearate ptxwdp ..... £253 10s.
Bi oflex 102 pt ..... £513—£568
Butyl Ricinoleate ..... 2s. 6d.—2s. 6½d.
But. Ac Ricinoleate .. 3s. 0½d.—3s. 1½d.
Butyl Stearate pt ..... £277—£282
Ca. Stearate ptcp £220

Diallyl Phthalate .... 3s. 11d.—4s. 11½d.
Dialkyl Phthalate pt ..... £221—£222
Dibutyl Phthalate pt ..... £203—£204
Dibutyl Sebacate ..... 5s. 9½d.
DiOA pt ..... £354—£357
DiOS sp ..... 5s. 0½d.—5s. 2d.
DOA pt ..... £414—£420
DOP pt ..... £276—£277
DOS sp ..... 5s. 7½d.—5s. 9d.
Disobutyl Phthalate pt ..... £196—£197
Diisooctyl Phthalate pt .... £221—£222
Dinonyl Phthalate pt ..... £211—£212
DNS sp ..... 5s. 2½d.—5s. 4½d.
Ester Gum pcag ..... 130s.—150s.
Flexol 3GO ..... 4s. 8d.
Hercolyn pc ..... 242s.—294s.
Lankroflex ED3 ..... 3s. 2d.—3s. 2½d.
Lankroflex 29 pt ..... £216—£217
Lead Stearate ptxwdp ..... £223 10s.
Methyl Ricinoleate .... 2s. 4d.—2s. 4½d.
Me. Ac Ricinoleate .. 2s. 11½d.—3s. 0½d.
Polyglycol Oleate 400 pt £285
Reomol D79A pt ..... £354—£357
Reomol D79S sp .... 5s. 0½d.—5s. 2d.
Reoplex 100 sp ..... 6s. 1½d.—6s. 2½d.
Reoplex 110 sp ..... 5s. 10d.—6s. 5½d.
Reoplex 220 sp ..... 5s. 6½d.—5s. 8d.
Reoplex 300 sp ..... 7s. 2d.—7s. 3½d.
Reoplex 400 sp ..... 4s. 2½d.—4s. 4d.
Rosin Oil pgag ..... 8s.—18s.
Triphenyl Phosphate pt £366
Tric esyl Phosphate pt £233
Trixylyl Phosphate pt £200
Zinc Stearate ptdel ..... £220—£230

Solvents and General Chemicals

Acetic acid ptdel ..... £77—£100
Acetic Anhydride ptdel £128
Acetone ptdel ..... £75—£120

Alcohol:
Absolute 74.5 op pgdel 4s. 0½d.—4s. 4½d.
Butyl pt ..... £132—£193 10s.
sec-Butyl ptdel ..... £128—£168
Ter-Butyl ptdel ..... £172—£195
Isopropyl Tech. 99% pgdel 5s.—6s. 5½d.
Butyl 'Carbitol' pt £283
Butyl Acetate pt ..... £159—£217
Caprylic Acid ptdel £395
Carbon Bisulphide ptxs ..... £71 10s.
Carbon Tetrachloride pg .. 12s. 4d.—20s.
'Cellosolve' Acetate pt £250
Cresol m- 98% del ..... 4s. 9d.
Cresol o- 30/31°C. del ..... 1s.
Cresol p- 34/35°C. del ..... 5s.
Ethyl Acetate pt ..... £131—£189
Formaldehyde ptdel £40

Glycol:
Diethylene pt £158
Ethylene pt £132
Polyethylene 200 pt £214
,, 300 pt £214
,, 400 pt £214
,, 1,500 pt £264
,, 4,000 pt £274
,, 6,000 pt £294
Isopropyl Acetate pt ..... £126—£184
Isobu yl Acetate 80% pt .. £126—£185
Lauric Acid ptdel £273
M.E.K. ptdel .... £134 10s.—£143 10s.
M.I.B.K. ptdel ..... £166—£209

Methylated Spirits pgdel:
Industrial 61op .... 5s. 5½d.—7s. 2d.
,, 74 op .... 6s. 3d.—7s. 11½d.
'Q' grade 68 op .. 8s. 5½d.—10s. 5d.
Pyridinised 66 op .. 5s. 10d.—7s. 6½d.
Denatured Methanol 3s. 9½d.—4s. 10d.
Monoethanolamine pt £252

Naphtha Coal tar pg:
Heavy 90—190 ..... 4s.
Light 90—160 ..... 5s. 1d.
Palmitic Acid ptdel £147
Phenol pldel ..... 1s. 4d.—1s. 7d.
Pyridine pg ..... 16s. 6d.
Stearine ptag ..... £108—£130
Toluol Pure/Nitration pg ..... 5s. 8d.
Toluol 90's pg ..... 5s.
Triethanolamine pt £224
Xylol 2/30 pg ..... 5s. 9d.

CLASSIFIED ADVERTISEMENTS

RUBBER AND PLASTICS WEEKLY

APPOINTMENTS VACANT

6d. a word, Minimum 12/6 Box 2/-

CHEMIST/technologist required by progressive and rapidly expanding company in the plastics field located in the Home Counties. Candidates should hold BSc or API qualifications, although consideration will be given to applicants who have had full experience in the compounding of PVC. Age preferred 23/30 years.—Box 903. (903)

EXPERIENCED rubber works foreman (nights). Good pay and prospects.—Apply Sam Kay Rubber Co. Ltd., Hope Mills, Portwood Place, Stockport. (876)

ENGINEER/rubber technologist wanted by London company for development work in rubber and expanded plastics. The post is permanent and offers excellent prospects. Applicants should state salary required, technical qualifications, etc. — Apply Box 921. (921)

LATEX foam chemist/technologist required by firm in Manchester area.—Write stating age, experience and salary required to Box 920. (920)

OPPORTUNITY occurs offering excellent prospects with Home Counties rubber manufacturers for energetic and enterprising individual as assistant to managing director. Experience and knowledge of rubber industry in relation to manufacturing and merchanting sales, purchases, correspondence and progressing an advantage.—Apply with full details of experience, age and salary required in strictest confidence to Box 884. (884)

STAFF APPOINTMENT

DESIGNER AND FITTER ENGINEER OF HOSE COUPLINGS

A vacancy exists for a new staff appointment with an old-established and progressive rubber hose manufacturer in Hertfordshire as a fitter engineer for designing and supervising the assembling of low pressure and high pressure cotton and wire braided hose couplings, and other hose fitting work.

Excellent prospects for staff promotion.

Age between 30 and 40 years. Previous experience very necessary.—Box 850. (850)

APPOINTMENTS VACANT

QUALIFIED CHEMIST

An attracive vacancy for a Chemist of degree or AIRI standard exists in a large progressive factory manufacturing rubber products in the West London area. Initially the appointment will involve process control work in one or more sections of the factory with responsibility for maintaining the consistency and seeking improvements of products in specific sections of the factory. The work will entail co-ordination with Production personnel and every encouragement will be given to promote this aspect of the work and to assist the successful applicant both educationally and within the organisation.

An attractive salary will be paid according to experience and the position qualifies for the contributory pension and life assurance scheme. — Write stating qualifications, experience and positions held to Box 922. (922)

MAINTENANCE engineers for rubber and plastic factory, fitter welder and fitter turner. Top rates paid to first-class men. — Apply to Works Manager, 243 Church Road, Mitcham, Surrey. (918)

QUALITY CONTROL

The North British Rubber Company have a vacancy in the Quality Control Department of their General Rubber Goods Division at Castle Mills, Edinburgh, for an experienced young man aged 21-30 possessing at least LIRI qualification. The successful candidate will act as Assistant Quality Control Manager with possibility of succession in due course. The Company offers the usual staff conditions. — Applications marked QC giving full details of qualifications and experience should be addressed to Industrial Relations Division, The North British Rubber Co., Ltd., Castle Mills, Edinburgh, 3. (923)

GRADUATE CHEMISTS

STOREYS OF LANCASTER have vacancies in their Development Department for qualified Chemists.

The Company manufactures PVC sheeting for many varied domestic and industrial uses and the importance of development is fully recognised. The Head Office and Works are in Lancaster, north of Lancashire's industrial belt and within easy reach of pleasant residential areas. Conditions of employment include a 5-day week and a contributory Superannuation Fund. High calibre chemists are required and a good class honours degree is essential. Post-graduate research and industrial experience will be welcome, as will applications from Chemists who will graduate later this year.

Applications in the strictest confidence should be addressed to the *Personnel Manager, Storey Brother and Company Limited, White Cross, Lancaster.* (930)

LARKHILL RUBBER COMPANY LTD.

until recently the Rubber Division of C. & J. CLARK LIMITED, SHOEMAKERS

wish to appoint

SHIFT FOREMEN

at their new factory at YEOVIL, Somerset

Supervisory and technical experience in the Rubber Industry is essential.

Starting salary will be in the region of £1,000 - £1,250. Three weeks' holiday and good pension scheme.

Applications are invited and should be made to the Senior Personnel Officer, C. & J. Clark Limited, Street, Somerset, marking your envelope 'Private' and quoting reference number JT:PJB:19:3. (902)

APPOINTMENTS VACANT

THE RUBBER REGENERATING CO. LTD.
wish to appoint a
PLASTICS TECHNOLOGIST
as
PRODUCTION SUPERVISOR

of all their thermoplastic operations at Trafford Park, Manchester.

The Company is marketing a range of thermoplastic raw materials principally for the toy and houseware trades and offering a Banbury compounding service to the plastics industry.

The man should preferably be aged 30/40, and have had experience of processing polystyrene, polyethylene and PVC on extruders, roll mills and Banbury mixers.

An attractive salary, good pension and other benefits are offered together with excellent prospects for the right man.

Please write in strict confidence to:
Personnel Manager,
The Rubber Regenerating Co. Ltd.,
First Avenue,
Trafford Park,
Manchester, 17. (928)

FOREMAN, experienced, required for night shift in rubber moulding press shop in Hertfordshire. Must be good organiser, able to control labour.—Apply with full details to Box 931. (931)

THE RUBBER RESEARCH INSTITUTE OF MALAYA

The Board of the Rubber Research Institute of Malaya invites applications for the post of Technologist in the Chemical Division of the Institute at Kuala Lumpur, Malaya.

The duties of the post are for the most part to undertake investigations applying research and development findings to field and factory practice. The work calls for ingenuity and invention as well as the ability to carry out systematic investigations over a period of time. The successful candidate will be expected to reside at the Experiment Station, Sungei Buloh, 17 miles from Kuala Lumpur, but may be required to undertake outstation duty visits of a few days' duration.

The applicant should possess an honours degree in science or equivalent qualification, together with several years' experience in the rubber producing industry. Preference will be given to candidates well acquainted with rubber and latex factory practice in Malaya.

Appointment will be on the Research Officer scale, the point of entry depending upon qualifications and experience. The basic salary of the appointment will be within the scale £1,400 x 70—£2,660 per annum. Allowances range from £140 to £630 per annum in accordance with country of domicile. An additional allowance towards education of children ranging from £140 to £420 per annum is payable to an employee of overseas domicile. There is a contributory provident fund.

Application forms and further particulars of the post may be obtained from the Secretary, Natural Rubber Bureau, Commonwealth Institute, Imperial Institute Road, London, S.W.7. Closing date for applications is April 24, 1961. (915)

WORKS CHEMIST

A well-known expanding company shortly transferring its production activi ies to Northern Ireland requires the services of a Chemist experienced in the compounding, moulding and treating of natural and synthetic rubbers.

A sound knowledge of control procedure is essential.

The prospects for an applicant with the desired abilities are excellent.

This appointment would ideally suit a person with suitable qualifications who originates from Ireland, and wishes to return.

The position would be at senior staff level, and superannuated.

Applications stating age, qualifications, married or single, and when available, should be addressed to **Box 893.**

(893)

APPOINTMENTS VACANT
(continued)

SERVICE engineer and demonstrator for injection moulding machines. Applicants should have experience of hydraulic equipment and also moulding technique. Appointment, which will be permanent and pensionable, is in London but will involve extensive travel. State age, education, training, experience and salary required.—Box 913. (913)

TECHNICAL assistant to works manager, preferably with AIRI qualifications, required for factory in Manchester area employing 250, and planning for increased production of general mechanicals and footwear. — Please reply stating experience and salary required, Box 916. (916)

YOUNG chemist/rubber technologist required by progressive rubber company. Minimum qualification BSc (chemistry), ARIC or AIRI. Industrial experience desirable but not essential. Newly qualified candidates will be considered.—Apply in writing to Andre Rubber Co. Ltd., Kingston By-Pass, Surbiton, Surrey. (909)

APPOINTMENTS WANTED

6d. a word, Minimum 10/- Box 2/-

EXECUTIVE, in mid-40's, long service in this industry, and experienced in most functions, seeks responsible and progressive position in factory management, sales or administrative capacity.— Box 925. (925)

This column can be YOUR best BUYER or SELLER

RUBBER & PLASTICS
MACHINERY
Why not see for YOURSELF

MACHINERY FOR SALE

6d. a word, Minimum 12/6 Box 2/-

'COTSWOLD' dipping machines and circulating tanks for latex and PVC. New catalogues now available on request. — Lionel Hook and Sons, Ebley, Stroud, Glos. Tel.: Stonehouse 614/5. (380R)

MANUFACTURERS of roughing machines for rubber sheeting, sponge rubber, splitting machines, leather cloth plant, embossing plates and rollers, spreading machines and presses.—G. L. Murphy Ltd., Imperial Works, Menston, Nr. Leeds. (238R)

NO. 11 Banbury. 8½in. extruder with 120/40 h.p. variable speed drive. 8in. Camelback extruder. 4½in. Camelback extruder. 48in. x 18in. calender with variable speed drive.—Reed Brothers (Engineering) Ltd., Replant Works, Woolwich Industrial Estate, London, S.E.18. Tel.: Woolwich 7611 (6 lines). (924)

PLASTIC injection moulding machine. Windsor 6oz. model SH6.—Fred Watkins (Engineering) Ltd., Coleford, Gloucestershire. Phone Coleford 2271/5. (863)

STEAM-HEATED rubber vulcanizing oven, 4ft. dia. x 6ft. long, in first-class condition.—Box 358. (358)

MACHINERY WANTED

6d. a word, Minimum 12/6 Box 2/-

WANTED. Heavy 2-roll cracker, complete with drive and motor.—Box 896. (896)

AGENCIES and REPRESENTATIVES

6d. a word, Minimum 12/6 Box 2/-

A WELL-KNOWN supplier of raw material to the rubber trade requires an additional sales representative to be based in the South of England. A technical background would be advantageous. Our own personnel are aware of this advertisement. — Replies in confidence to Box 926. (926)

Butyl | **SEALANTS LTD**

for

LAMINATES · SHEET · SPONGE · STRIP

(929)

AGENCIES and REPRESENTATIVES

TECHNICAL SALES REPRESENTATIVE
to the
RUBBER AND ALLIED INDUSTRIES

Applications are invited for the above position, which will entail considerable travel both in the United Kingdom and overseas.

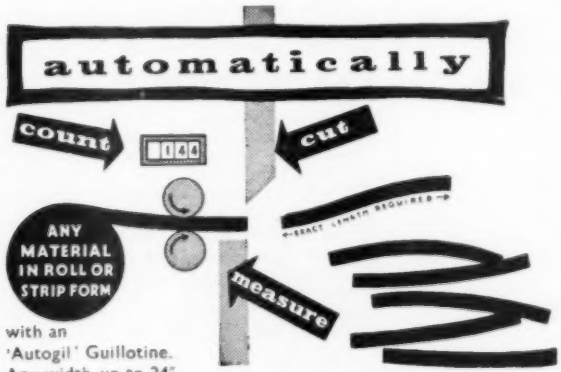
The age group is 30 to 40, and candidates should have a forceful character and strong personality. A sound knowledge of rubber compounding backed by a technical qualification is essential, as is experience of customer technical service and selling to industry at all levels.

Linguistic ability in French and German would be advantageous.

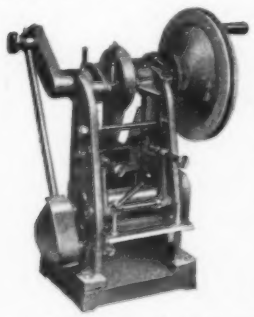
Pension and life assurance benefit schemes are in operation.

Applications, which will be treated in strict confidence, should give full details in the first instance, and be addressed to:

The Personnel Manager,
The Rubber Regenerating Co. Ltd.,
Trafford Park,
Manchester, 17. (927)



with an 'Autogil' Guillotine. Any width up to 24".



Operating automatically, 'Autogil' guillotines will cut 10 to 300 pieces per minute while an operator using scissors is still marking out the material.

Plastics . . . felt . . . fibre . . . ribbon . . . cardboard . . . foam rubber, and other soft materials up to ¼" thick; metal up to .025" thick, an 'Autogil' cuts them all accurately, speedily and uniformly into pieces of any length at all.

Your samples trial-cut by return.

AUTOMATIC Autogil GUILLOTINES

Write to Dept. A16 for full details of: 'Autogil' 4" to 24" guillotines. 'Autogil' tube-cutter. 'Autogil' No. 5 press.

WALLIS ENGINEERING CO. (BIRMINGHAM) LTD.
399 WARWICK ROAD, BIRMINGHAM, 11
Phone: ACOcks Green 4765 Grams: AUTOGIL BIRMINGHAM 11

ARTICLES FOR SALE

6d. a word, Minimum 12/6 Box 2/-

FOR sale. 8,300-lbs. neoprene type CG, 12/15 months old. Original bags. Very low price. Sample and details sent on request. — Box 919. (919)

FOR disposal. Several tons of scrap arising from natural and synthetic rubber production. Also PVC scrap in coated canvas and compounded strip. — Offer to Works Manager, 243 Church Road, Mitcham, Surrey. (917)

FOR SALE
Regular quantities of sorted Resin and Micro Rubber waste for disposal, all colours in stock, always 200 tons in stock.
Apply Leather Components and Waste Ltd.,
21 Harborough Road,
Rushden, Northants.
Phone Rushden 3687, evenings Rushden 3329.
(906)

REGULAR BUYERS **P.V.C.** SHEET SCRAP
MICHAEL S. STEVENS LTD
STATION WORKS, 75c UPPER RICHMOND RD., S.W.15
VANDYKE 6925 (739)

ARTICLES WANTED

6d. a word, Minimum 12/6 Box 2/-

THERMOPLASTIC scrap. We always buy large and small quantities and pay prompt cash.—Send offers to J. W. Nash and Co., Ltd., 27 Beethoven Street, London, W.10. Ladbroke 4655. (531)

CAPACITY AVAILABLE

6d. a word, Minimum 12/6 Box 2/-

SLITTING capacity. Plastic sheetings slit to narrow widths 3/16in. to ¼in.—Enquiries to Bias Bindings Co. Ltd., Gorgie Road, Edinburgh. (889)

BUSINESS OPPORTUNITIES

6d. a word, Minimum 12/6. Box 2/-.

REQUIRED. Firm with capacity for supplying an extruded section from re-processed PVC scrap material in standard colours.—Send particulars to Box 908. (908)

Advertisers

please note Easter publishing arrangements. We close for press March 28 for our April 1 issue. ***POST EARLY***

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